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SPECIFIC AND INDIVIDUAL VARIATION IN REDUCTION OF THE CLAVICLES IN THE PARROTS[1]

FRED H. GLENNY, F.A.Z.

Youngstown University, Youngstown 2, Ohio

It becomes increasingly evident, upon examination of the furcula or clavicles of birds, that this bony element is undergoing reduction in several genera of parrots, and that there may be reasonable variation in both length and heft of the bony elements which may remain.

In 1954, Glenny and Friedmann pointed out that there is no positive correlation between reduction in the clavicles and reduced flight function. A similar conclusion could be drawn from the study of the reduced clavicles of *Otidiphaps nobilis* (Glenny and Amadon, 1955). It may be concluded, however, that a factor for clavicle reduction or atrophy appears to be in operation in several orders and families of birds. Among the parrots, 19 of 67 genera studied show either instances of or major advances in the reduction of the clavicles.

In accordance with my former scheme of furcula classification (Glenny, 1954), Class 1 is complete (united clavicles); Class 2 is reduced to a ligament at the sternal end, but the bony element is retained for about one-half or more of the normal length of the clavicle; Class 3, the furcula is reduced to a ligament for the greater part of its length with the epicleidium remaining as a bony vestige (a relatively short portion of the *corpus claviculi* may or may not remain); and Class 4, the *ligamentum claviculi* alone remains and the epicleidium is entirely lost.

In genera of parrots showing constancy in reduction of the clavicles, Class 2 clavicles are found in *Strigops habroptilus* alone. It should be remarked, however, that Class 2 clavicles may appear in genera predominantly of Class 1. Examples of this are to be found in *Eos squamata guenbyensis*, *Brotogeris cyanoptera*, and *Psittacus erithacus*. Class 3 clavicles predominate in the following genera: *Micropsitta*, *Agapornis*, *Platycercus*, *Purpureicephalus*, *Northiella*, *Psephotus*, *Neophema*, *Cyanoramphus*, and *Melopsittacus*.

In *Forpus* Class 3 and Class 4 conditions are of about the same occurrance and one class is not to be regarded as offering value as a specific criterion over the other.

In addition, clavicles of Class 3 are found to occur in genera and species normally accepted as having Class 1 clavicles. Some examples of this condition may be cited: *Domicella garrula*, *Charmosyna papou stellae*, *Poicephalus senegalus senegalus*, *Polytelis anthopeplus*.

On the other hand, a Class 1 clavicle was found in a specimen of *Psephotus chrysopterygius*. Some other variations are in:

Psitteuteles flavoviridis meyeri	Class 1
Psitteuteles versicolor	Class 3
Opopsitta diophthalma	Class 1
Opopsitta sp.	Class 3

[1]This study was made possible, in part, under National Science Foundation Grant 4992.

Geoffroyus geoffroyi aruensis—showed a Class 4 clavicle, but *Geoffroyus* may well fall into a Class 3–4 complex, as is the case with *Forpus*.

This study included 67 genera, 221 species and subspecies, and 399 specimens of parrots. Among the Class 1 furcula forms, there are notable differences in the heft or thickness of the *corpus claviculi*. Of three skeletons of *Domicella garrula*, in the British Museum (N.H.) collection, one was strong or fairly heavy, one was of moderate heft, while the remaining one was of slight build. Among several other genera, there were noticeable individual differences in the heft of the furcula.

Variation in the length of the bony vestiges was also notable in several species. Four specimens of *Strigops* show some of the range in measurements of the clavicles: 2.3, 2.4, 2.5, and 3.3 cm. In *Agapornis pullaria*, 3 (2.5 mm), 2 (3 mm), and 1 (4 mm); *Agapornis cana*—1 (2.5 mm) and 1 (3 mm); *Platycercus caledonicus*—1 (4.5 mm) and 1 (5 mm); *Platycercus eximus*—1 (3 mm) and 2 (5 mm); *Platycercus zonarius barnardi*—1 (6 mm), 1 (6.5 mm), and 1 (8 mm); *Melopsittacus undulatus*—1 (2.5 mm) and 3 (2 mm).

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QUANTITATIVE DETERMINATION OF TRACE AMOUNTS OF CARBONYL COMPOUNDS. I. THE PREPARATION OF 2-(4'-PHENYLAZO) PHENYLHYDRAZINE SULFONIC ACID

EARL W. MALMBERG,[1] D. L. FISHEL[2, 3] AND BORIS WEINSTEIN[4, 5]

Department of Chemistry, The Ohio State University, Columbus 10

The compound 2-(4'-phenylazo) phenylhydrazinesulfonic acid or azobenzene-*p*-phenylhydrazinesulfonic acid is used in the qualitative trace determination of aldehydes and ketones (Feigl, 1956). The test is carried out in a strongly acidic solution with heating, and the colored reaction product is extracted with chloroform in the presence of ethanol. This reaction has recently been examined in detail and applied to the quantitative determination of trace acetaldehyde in air (Malmberg et al., 1959). The sensitivity and reproducibility of the procedure is greatly dependent upon the reagent quality.

Azobenzene-*p*-phenylhydrazinesulfonic acid is best synthesized by passing sulfur dioxide gas into a benzenediazonium sulfate solution. The original preparation contains several unaccountable features and is vague about the final purification of the product as the ammonium salt (Tröger and Müller, 1908). A latter account mentions the compound as purified via the *p*-toluidine salt (Tröger and Westerkamp, 1909).

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[1]Present address: The Sun Oil Company, Philadelphia, Pennsylvania.

[2]Research Assistant, The Ohio State University Research Foundation, 1955.

[3]Present address: Department of Chemistry, University of South Dakota, Vermillion, South Dakota.

[4]Research Assistant, The Ohio State University Research Foundation, 1955–56.

[5]Present address: Department of Chemistry, University of California, Berkeley, California.

Modifications of the old method have now given the acid in better yield. In addition, azobenzene-*p*-phenylhydrazinesulfonic acid has been made by adding sodium phenylhydrazinesulfonate to benzenediazonium sulfate solution. This latter synthesis is new and of interest since it involves a coupling sequence with a negative ion. An alternate route with benzenediazonium chloride solution and benzenediazosulfonate has been stated as not workable (Hodeson and Marsden, 1943). Finally, an attempted bisulfite reduction of diazotized *p*-aminoazobenzene gave only the diazosulfonate here.

EXPERIMENTAL PROCEDURE

Azobenzenephenylhydrazinesulfonic acid. (a) *From aniline.*—Into a three necked 1-l round-bottomed flask equipped with dropping funnel, stirrer, and gas inlet tube and containing 49.0 g (0.50 mole) of concentrated sulfuric acid in 200 ml of water were added with stirring 23.5 g (0.25 mole) of aniline. When the aniline had dissolved, 200 ml of cold water were added and the mixture was chilled to 0° C. A cold solution of 18.0 g (0.26 mole) of sodium nitrate in 35 ml of water was added slowly, so as to maintain the stirred solution below 5° C. The last few milliliters of the nitrate solution were added dropwise, using potassium iodide-starch paper to mark the end point. Sulfur dioxide gas was then bubbled at a rapid rate into the stirred solution over a four-hr period. The clear liquid rapidly changed into a frothy, red suspension which was allowed to stand overnight. The product was collected, washed copiously with cold water, and sucked dry. The reddish-purple material was treated with several portions of boiling benzene to remove soluble impurities, collected and air dried, wt. 19.8 g (55.0%); mp 99.0–100.0°C, with decomposition (block, uncorrected); literature mp 99.0–100.0°C.

Anal. Calcd. for $C_{12}H_{12}N_4O_3S \cdot 1\frac{1}{4}\ H_2O$: C, 45. 78; H, 4. 64; S, 10.19.

Found: C, 45. 94; H, 4. 79; S, 10.04.

For further purification, the acid was dissolved in a hot, saturated ammonium acetate solution and the ammonium salt was allowed to crystallize out. The monohydrate was collected, washed with cold water, and dried: mp 164.0–165.0° C, with decomposition. The free acid was obtained by adding the ammonium azobenzenephenylhydrazinesulfonate monohydrate to cold, dilute mineral acid and collecting the precipitated acid which was washed and dried.

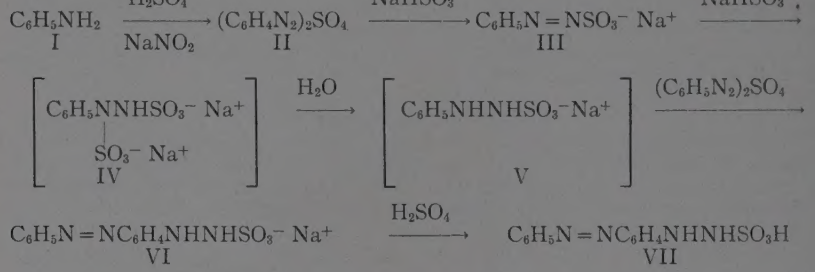
(*b*) *From sodium phenylhydrazinesulfonate.*—As described, 7.75 g (0.082 mole) of aniline were diazotized and 19.0 g (0.082 mole) of sodium phenylhydrazinesulfonate monohydrate (see below) in 100 ml of cold water were added dropwise with stirring. After standing overnight, the solid was collected, washed and dried: wt. 4.4 g (17.0%). In a neutralized diazonium solution, the coupling gave a yield of 6.5 g (25.0%). The infrared spectrum was identical with the material prepared through the use of sulfur dioxide.

(*c*) *From* p-*aminoazobenzene.*—Conventional reduction of diazotized *p*-aminoazobenzene with aqueous sodium bisulfite gave only the insoluble intermediate diazosulfonate. The same result has been reported by other workers (Hodeson and Marsden, 1943).

Sodium phenylhydrazinesulfonate.—The original method was modified as follows (Bücherer and Schmidt, 1909). A mixture of 40 g (0.37 mole) of phenylhydrazine and 400 ml of 36 percent sodium bisulfite solution was refluxed for two days. The solution was extracted with three 200 ml portions of hot benzene and then treated with Darco, filtered, evaporated down to a 100 ml volume, and chilled to give 42.0 g (49.2%) of the monohydrate (three crops): mp 118–120° C (loss of water) and decomposition beginning at 240° C (reported mp 120° C). As a check upon the structure assigned to this compound, 0.1 g was dissolved in 5 ml of water and mixed with 5 ml of commercial Chlorox (sodium hypochlorite solution). An immediate yellow precipitate appeared, due to oxidation of the sodium phenylhydrazinesulfonate to sodium phenylazosulfonate.

DISCUSSION

The mechanism for azobenzene-*p*-phenylhydrazinesulfonic acid formation from aniline may be written as follows:



The intermediates II to V are conventionally written for the conversion of aniline to phenylhydrazine (Rodd, 1954). The sequence V to VI is supported by the observed reaction between sodium phenylhydrazine sulfonate and benzenediazonium sulfate. Also, these coupling reactions are analogous to those between the sodium salt of aniline-ω-methanesulfonic acid and diazonium reagents (Kaplan, 1954).

The infra-red spectrum of azobenzene-*p*-phenylhydrazinesulfonic acid can be rationalized with the accepted structure. The spectrum provides a satisfactory means of evaluating the purity of the reagent. The absorption bands are assigned as follows: 3300 (-NH-), 3030 (Nujol), 3000 (Nujol), 1845 (-C=C-), 1600 (-C=C-), 1585 (-C=C-), 1580 (-N=N-), 1475 (Nujol), 1380 (Nujol), 1340 (-C-N), 1338 ($-SO_2-$), 1240 (-$NHSO_3H$), 1150 ($-SO_2-$), 1083 (mono or 1,4 substitution), 1050 ($-SO_3H$), 1000 (mono or 1,4 substitution), 840 (1,4 substitution), 825 (phenyl), 760 (Nujol), and 755 (monosubstitution) cm^{-1}.

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A NEW GENUS, *RENONUS*, AND TWO NEW SPECIES OF MEXICAN LEAFHOPPERS

(HOMOPTERA: CICADELLIDAE)

DWIGHT M. DELONG

Department of Zoology and Entomology, The Ohio State University, Columbus 10

Among the Mexican material studied during the past few years a species is described below which is being placed in a new genus, *Renonus*. Also a well marked species is described as a member of the genus *Chlorotettix*.

Renonus n. gen.

Type of Genus Renonus rubraviridus *new species*.—Related to *Mesamia* Ball but with different wing venation and distinctive male genital structures. Crown rather broad and flat with a shallow depressed furrow considerably back of margin. Crown and face forming a rather sharp

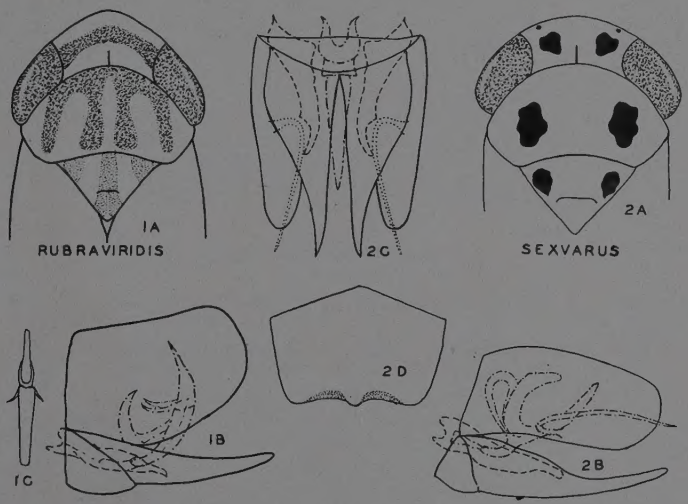

FIGURE 1. *Renonus rubravitidis*. A—head, pronotum and scutellum (dorsal view). B—lateral view of male genital chamber showing aedeagus and styles in normal location. C—ventral view of aedeagus.

FIGURE 2. *Chlorotettix sexvarus*. A—head, pronotum and scutellum (dorsal view). B—lateral view of male genital chamber showing lateral view of aedeagus and style. C—ventral view of male genital chamber. D—ninth sternite of female.

acutely angled margin. Forewing with a narrow appendix, the inner anteapical cell not closed, and without extra cross veinlets of any type throughout the forewing. Male pygofer without a caudal spine. Plates elongate tapered to narrow rounded apices. Aedeagus appearing tubular, curved at base to an erect position in the genital chamber. In lateral view it appears narrowed at base then gradually enlarged and tapered to a flattened or slender apex. A pair of lateral processes arise at about two thirds its length and extend cephalad into the genital chamber. The female is unknown.

Renonus rubraviridis n. sp.

Figure 1

A green leafhopper with red markings and resembling a species of *Mesamia* in general form. Length male 4.5–5mm crown rather broad and flat almost two-thirds as long at middle as basal width between the eyes. A shallow depressed furrow a little posterior to margin. The margin appears sharply angled with face. Forewing with simple venation, without extra cross veins.

Color.—Face pale yellow; crown, pronotum and scutellum pale to bright green marked with red. The red markings consist of a broad red transverse band extending between the eyes at about the middle of the crown and parallel to the posterior margin. Pronotum with a rather broad transverse band along the anterior margin extending between the middle of the posterior margins of the eyes. From this, four longitudinal red stripes about as broad as the transverse stripe extend posteriorly to the posterior margin of the pronotum and are about equidistant from each other and from the lateral margins of the pronotum. The middle pair are slightly enlarged on the outer margins before they reach the posterior margin. Scutellum with an orange red spot in each of the three angles. Forewings yellowish transparent, usually without coloring but with faint white areolar spots along the inner margin of clavus. In dark specimens the veins may be margined with dark brown.

Genitalia.—Male plates elongate, each plate about two and one-half times as long as basal width, tapered to a narrow rounded apex. Styles rather broad, triangular, distinctly shorter than combined width at base. Aedeagus cylindrical, curved at base to an erect position in the genital chamber. The apical third appears to be fitted into the basal portion. A pair of spinelike processes arise at this junction and extend cephalad into the genital chamber. In lateral view the aedeagus is enlarged near the base then tapers to form a thin apical portion.

Holotype male collected at Iguala Guerrero, Mexico, September 11, 1939 by D. M. DeLong. Paratype males collected at Zincauro, Guerrero, September 2, 1930 and Santa Tomas, August 14, 1930 by J. Parra; Reforma, Tabasco, June 23, 1938 and El Mante Tamaul, Mexico by Alfonse Dampf.

Chlorotettix sexvarus n. sp.

Figure 2

A rather small species with a broadly rounded head and marked with six large black spots. Length, 5 to 6 mm.

Crown appearing parallel margined, almost twice as wide between eyes at base as median length, front margin broadly rounded.

Color.—Pale to brownish yellow, with three pairs of conspicuous black spots. A pair on the crown are rounded and close to the margins of the eyes and a little closer to the anterior than the posterior margin of the crown. A pair on the pronotum are usually larger, especially in the male specimens. These are more elongate and are separated a little farther from each other so that they are located at about the middle of the pronotum behind the inner portion of each eye. A third pair which are variable in size are located on the basal angles of the scutellum. Forewing may be marked with a small brown spot on the middle of the wing not far from base and usually with some spots of dark brown pigment along the inner margin of the clavus.

Genitalia.—Female seventh sternite with posterior margin almost truncate, slightly produced to form a blunt tooth at middle. A dark brown border either side of middle causes it to appear excavated. Male plates rather long, strongly concavely tapered on apical half to produce acutely pointed apices. Styles long, gradually narrowed to form fingerlike apices which are curved outwardly. The aedeagus is composed of two parts, a rather heavy portion curves dorsally and slightly anteriorly, and a more caudal process extends dorsally and caudally. A slender curved process arises on the medial anterior margin of the anterior process and curves anterio-dorsally then recurves to the base of the anterior process.

The pygofer has a long slender spine which arises ventrally at about the middle and extends caudally beyond the posterior margin.

Holotype male and paratype male labeled "Mexico, October 8" were collected by Dr. Alfonse Dampf. The female allotype was collected at Fortin Veracruz, Mexico, October 9, 1941 by DeLong, Good, Caldwell and Plummer. Paratype female collected at Tuxpan, Michoacan, Mexico December 9, 1929 by Dr. Dampf.

POTENTIAL ANTICANCER COMPOUNDS. II.[1] SYNTHESIS OF SOME NITROSIMINODIACETIC ACID HYDRAZIDES

HANS ZIMMER AND B. K. NARAYANA SWAMY[2]
Department of Chemistry, University of Cincinnati, Cincinnati 21

The activity of bis (2-chloroethyl) sulfide and of several N-analogs (nitrogen mustards) against certain types of cancer is well established. However, besides a more or less pronounced toxicity, all of these compounds suffer from several other unfavorable physiological properties. Therefore, the synthesis of compounds was undertaken which have the structural element $\begin{matrix} -N-CH_2- \\ | \\ CH_2- \end{matrix}$ of the nitrogen mustards but which have instead of the CH_2Cl-unit the groups $-C(O)-NHN=R$ (R = arylidene) or $-C(O)-NHNRR'$ ($R=H$, $R'=C_6H_5$; $R=R'=CH_3$). Since certain N-oxides (Ishidate, 1954) of the nitrogen mustards have been found to possess valuable anticancer properties, the group $N-N=O$ resembling somewhat the $\equiv N\rightarrow O$ unit was incorporated into the compounds. It was hoped that these compounds would retain anticancer activity but exhibit less unfavorable side-effects than nitrogen mustard itself or the other compounds of this class. The $-C(O)-NHN=$ group was chosen to provide the compounds with some hydrophilic solubility. Preliminary tests against three types of experimental tumors in mice, Adenocarcinoma (Ca-755), Sarcoma (Sa-180), and Leukemia (L-1210), however, reveal so far no activity against these tumor systems.

The compounds were prepared by established methods. Diethyl iminodiacetate was nitrosated and the diethyl nitrosiminodiacetate formed was converted into the corresponding hydrazides by being refluxed with an excess of the corresponding hydrazine in the presence of a few drops of glacial acetic acid as a catalyst. The nitrosiminodiacetic acid dihydrazide was converted into the hydrazones by the method of Zimmer and George (1956). The hydrazones were rather insoluble in most of the common solvents. They could best be recrystallized from aqueous N, N-dimethylformamide.

Attempts to prepare the corresponding hydrazides of 3,3'-nitrosiminodipropionic acid met with failure. The corresponding diethyl ester did not react with hydrazine or with 1,1-dimethylhydrazine. The failure of the latter to undergo the expected reaction is in agreement with similar results published recently by Hinman and Fulton (1958). Even after 48 hours refluxing of the mixtures with hydrazine or 1,1-dimethylhydrazine respectively, and diethyl 3,3'-nitrosiminodipropionate none of the corresponding hydrazides could be obtained. Also, the heating of these mixtures for 48 hours in pressure bottles did not yield the desired hydrazides.

EXPERIMENTAL METHODS AND RESULTS

Melting points are uncorrected. Microanalyses are by A. Bernhardt, Microanalytisches Laboratorium im Max-Planck-Institut, Mulheim/Ruhr, Germany.

Materials. Generally, Eastman white label products were employed without further purification.

Nitrosiminodiacetic acid, bis (p-*methoxybenzylidene-hydrazide*). A solution of 2.5 g of nitrosiminodiacetic acid, dihydrazide in agueous ethanol was added to a solution of 4 g of anisaldehyde in ethanol. After the mixture had stood for a

[1]First paper in this series: H. Zimmer and E. Shaheen, Potential anticancer compounds. I. Synthesis of thiodiarctic acid hydrazides and homologs. J. Organic Chem. **24**, 1140–1144, (1959).

[2]National Institute of Health Fellow 1957–1958.

brief period, the hydrazide precipitated. The crystals were recrystallized from aqueous N,N-dimethylformamide, yield 5 g (89%), mp (unc) 252–253° C.

Anal. Calcd. for $C_{20}H_{22}N_6O_5$: C, 56.33; H, 5.20; N, 19.71.

Found: C, 56.29; H, 5.21; N, 19.65.

Analogously, the following hydrazides were prepared:

Nitrosiminodiacetic acid bis (*o-hydroxybenzylidene-hydrazide*). From salicylaldehyde, 76% yield, mp (unc) 232–233° C.

Anal. Calcd. for $C_{18}H_{18}N_6O_5$: C, 54.27; H, 4.55; N, 21.10.

Found: C, 54.17; H, 4.44; N, 20.95.

Nitrosiminodiacetic acid, bis (*p-chlorobenzylidene-hydrazide*). From *p*-chlorobenzaldehyde, 85% yield, mp (unc) 252–253° C.

Anal. Calcd. for $C_{18}H_{16}Cl_2N_6O_3$: C, 49.67; H, 3.71; N, 19.32.

Found: C, 49.40; H, 3.64; N, 19.03.

Nitrosiminodiacetic acid, bis (*cinnamylidenehydrazide*). From cinnamaldehyde, 82% yelid, mp (unc) 231–232° C.

Anal. Calcd. for $C_{22}H_{22}N_6O_3$: C, 63.14; H, 5.26; N, 20.09.

Found: C, 63.37; H, 5.53; N, 20.30.

Nitrosiminodiacetic acid, bis (m-*nitrobenzylidenehydrazide*). From *m*-nitrobenzaldehyde, 67% yield, mp (unc) 246–247° C.

Anal. Calcd. for $C_{18}H_{16}N_8O_7$: C, 47.37; H, 3.53; N, 24.56.

Found: C, 46.80; H, 3.53; N, 24.50.

Nitrosiminodiacetic acid, bis (*2.2-dimethylhydrazide*). A mixture of 20 g diethyl nitrosiminodiacetate and 80 ml 1,1-dimethylhydrazine and a few drops glacial acetic acid was refluxed for 8 hours. Excess dimethylhydrazine was distilled off; on cooling the hydrazide crystallized, white crystals (17.5 g 78%). The analytical sample was recrystallized from diozane or ethyl acetate, mp (unc) 182–183° C.

Anal. Calcd. for $C_8H_{18}N_6O_3$: C, 39.01; H, 7:37.

Found: C, 38.83; H, 7.40.

Nitrosiminodiacetic acid, bis (*2-phenylhydracide*). Analogously from phenylhydrazine, 75% yield, mp (unc) 234-235° C. The analytical sample was recrystallized from N, N-dimethylformamide—water.

Anal. Calcd. for $C_{16}H_{18}N_6O_3$: C, 56.13; H, 5.30.

Found: C, 56.14; H, 5.26.

Diethyl 3, 3'-nitrosiminodipropionate. This substance was obtained in good yield by nitrosation of diethyl 3, 3'-iminodipropionate, yielding a liquid bp 129–130° at 0.1 to 1.0 mm Hg.

Anal. Calcd. for $C_{10}H_{18}N_2O_5$: C, 48.77; H, 7.37.

Found: C, 48.80; H, 7.49.

This compound did not react with hydrazine or with 1,1-dimethylhydrazine under the mentioned conditions.

ACKNOWLEDGMENTS

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REDESCRIPTION OF *ALLOLOBOPHORA MULDALI* OMODEO 1956

(LUMBRICIDAE: OLIGOCHAETA)

W. R. MURCHIE
University of Michigan Flint College

The present state of oligochaete taxonomy requires that specific diagnoses embody rather extensive descriptions. Reliance on too few anatomical features not only renders determination of conspecificity difficult but limits the possibilities for establishment of interspecific relationships at generic level. The earthworm to be considered in this paper was originally described as *Allolobophora minima* Muldal 1952 on the basis of material collected in Hertshire, England. The species has been renamed as *Bimastos muldali* Omodeo 1956 (p. 179, footnote) because of preoccupancy by *A. minima* Rosa 1884. Gates (1958) has indicated that the transfer to *Bimastos* is presently unacceptable. He has, at the same time raised the question of possible conspecificity of *A. norvegica* Friend 1913, *A. icenorum* Pickford 1926, and *A. muldali*. Too little evidence is available to permit a clear decision on this point. Murchie (1955, 1956) reported *A. muldali* for Michigan and presented the salient features in the life history of this species.

Muldal's original description is incomplete (Gates, 1958) and appears, in some respects, to be inapplicable to Michigan specimens described here (extent of the gizzard, position of last hearts, location of first dorsal pore). Inasmuch as these characters are subject to misinterpretation, and in view of substantial similarity on so many other points, I believe it advisable to consider the British and American representatives identical. I should like to express my appreciation to Dr. B. I. Roots, Royal Free Hospital School of Medicine, London, England, for notes on British material and to Dr. G. E. Gates for his valuable suggestions on analytical procedures.

Allolobophora muldali (Omodeo) 1956
Allolobophora mimima Muldal 1952: 463
Allolobophora minima Murchie 1955: 241
Bimastos muldali Omodeo 1956: 179
Allolobophora muldali Gates 1958: 39

Length 40–60 mm, average 48 mm. Diameter anterior to clitellum 1.2–2.0 mm. Colorless; clitellum opaque, whitish. Somites 87–97, average 95. Prostomium epilobous $\frac{1}{2}$. First dorsal pore $\frac{11}{12}$. Clitellum on XXVII–XXXIII, extending midventrally from seta *a* distance equal to *ab*. Tuberculae pubertates absent. Tail region truncate with midventral groove passing anteriorly at least 6 somites. First nephropore in III; here, and in succeeding somites, at anterior edge of somite, dorsal to *b* distance equal to $\frac{2}{3}$ *ab*. Setae closely paired; $aa = 7ab$, $ab = cd$, $bc = 4.5\ ab$, $dd = \frac{1}{6}\mu$. Genital setae not modified.

Male pore on XV, between *b* and *c*, slightly closer to *c*, near top of cleft in porophore. Tumesence of male porophore extends ventrad from setal line c to include *ab*; covers XV and parts of XIV and XVI. Female pore on XIV; slightly anterodorsal to *b*. Midventral portion of XI–XVI may be somewhat glandular.

Esophagus from $\frac{1}{2}$V through X; well-developed esophageal pouches in X. Calciferous gland XI–XIV; lamellae 30–38 in number beginning at $\frac{10}{11}$. Crop in XV; esophageal valve to gizzard. Gizzard including XVI and XVII. Typhlosole begins in XX; maximum height $\frac{1}{2}$ inner diameter of intestine. Typhlosole continues, with gradually diminishing height, to terminal segments. Septa $\frac{6}{7}$ and $\frac{7}{8}$ somewhat thickened; $\frac{8}{9}$ much thickened. Pharyngeal gland masses extend into IX. Nephridia vesiculate. Hearts VI–XI; extraesophageal vessels arise in XII; subneural trunk present. Longitudinal muscle bundles of pinnate type.

THE OHIO JOURNAL OF SCIENCE 59(6): 329, November, 1959.

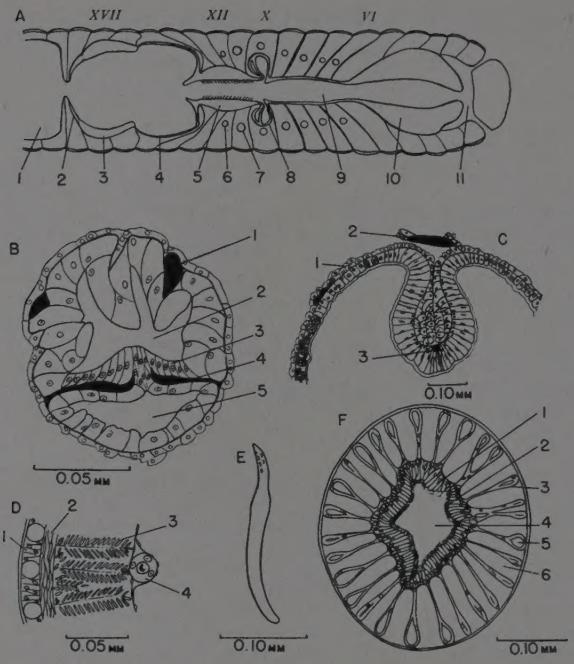

FIGURE 1

A. Diagram of frontal section through *Allolobophora muldali* showing relationship of parts of digestive tract.
   (1) Intestine
   (2) First segment of intestine which shows gizzardlike thickening of wall
   (3) Gizzard
   (4) Crop
   (5) Calciferous gland
   (6) Extra-esophageal vessel
   (7) Last lateral heart
   (8) Esophageal pouch
   (9) Esophagus
   (10) Pharynx
   (11) Buccal cavity

B. Section of esophageal pouch in X.
   (1) Minor vessel in anterior wall
   (2) Lumen of anterior portion of pouch
   (3) Epithelium of calciferous gland extending into pouch
   (4) Anterior extension of interlamellar sinus
   (5) Lumen of posterior portion of pouch

C. Portion of intestine showing typhlosole
   (1) Chloragogen layer
   (2) Dorsal vessel
   (3) Typhlosolar vessel

D. Portion of body wall in cross section; anterior part of segment XIII
   (1) Epithelial layer
   (2) Circular muscle layer
   (3) Longitudinal muscle layer, pinnate type
   (4) Male gonoduct with contained sperm

E. Seta *a* of XV

F. Cross section of calciferous gland in XII
   (1) Ciliated epithelium
   (2) Cilia
   (3) Lamella
   (4) Lumen
   (5) Intralamellar tunnel
   (6) Interlamellar sinus

Two pair of testes and funnels free in X and XI; no postseptal epididymal looping of male gonoduct. Male ducts of each side internal to muscle layers; join in XII. No atrium; glandular development of XIV, XV, and XVI external to circular muscle layer. Seminal vesicles 2 pair, in XI and XII from $^{10}/_{11}$ and $^{11}/_{12}$. One pair of ovaries and funnels in XIII; up to 5 ova in single strand from each ovary. Paired ovisacs in 14, from $^{13}/_{14}$ dorsomedian to funnel. Seminal receptacles absent.

Discussion

The extraesophageal vessels in this earthworm, as is the case with many lumbricids, might be misidentified as a pair of lateral hearts (fig. 1A–6). They arise from the dorsal vessel in XII, pass ventrad as would the hearts, but near the midlateral aspect of calciferous gland each vessel turns directly forward into segment IX where it bends dorsad and enters the esophageal region. From their point of origin, the extraesophageals neither give nor receive branches until segment VIII is reached. Dr. Roots has indicated (personal communication) a similar condition in British specimens.

Muldal described the gizzard as extending into XVIII. Michigan earthworms of *muldali* do show a thickened gizzardlike wall in this region, however, the nature of the epithelium and the absence of cuticular lining indicate that this should be considered, at most, a transition zone (fig. 1A–2).

A pair of well-developed, fingerlike esophageal pouches arises from the dorsolateral aspect of the gut in X. These project downward, nearly the full depth of the esophagus (fig. 1A–8). Frontal sections reveal each pouch to be formed of two chambers. The anteromost of these (fig. 1B–2) opens dorsally into the esophagus proper; the posterior chamber communicates dorsally with the intralamellar tunnels of the calciferous gland. These chambers join at the ventral (distal) end of the pouch forming a continuous, U-shaped passage from the esophagus to the intralamellar tunnels. The calciferous gland itself extends from $^{10}/_{11}$, without constriction, to $^{14}/_{15}$.

Lamellae of the calciferous gland branch repeatedly so that the total count will vary depending upon the level examined (fig. 1–F); thirty-four may be taken as an average with variation from 30 to 38. Interlamellar sinuses are large (fig. 1F–6); they are continuous with circulatory elements of the esophageal pouch. Paired vessels arise in X, XI, and XII from the dorsal vessel and supply the pouch and calciferous gland.

Muldal described and figured "pits" along the ventral edge of the clitellum at $^{28}/_{29}$–$^{31}/_{32}$, in line with setae *ab*. Fully clitellate worms collected in Michigan show similar depressions. These pits should not, in my estimation, be considered as related in any way with the formation of tuberculae pubertates but rather as artifacts resulting from clitellar development at the intersegmental furrows.

Whitish irridescence on the sperm funnels is construed as an indication of biparental reproduction by lumbricid worms. This condition obtains for *Allolobophora muldali*; in addition, histological sections reveal sperm on the funnels and in the lumen of the gonoduct as well (fig. 1D–4). Copulation has been observed (laboratory cultures) and individuals bearing spermatophores collected (Murchie, 1956).

None of the cocoons seen by the writer has had more than one developing embryo. Constancy of this condition, plus possible obligatory biparental reproduction may be suggested as mechanisms acting to restrict distribution of *Allolobophora muldali*. The specimens upon which this study is based, were taken from a substantial but restricted population located in a wooded ravine along the Huron River shore northwest of Ann Arbor, Michigan. Evidence of endemicity, on the basis of presently known populations, permits us to judge only that *muldali* is a soil species, requiring stable soil-moisture conditions. Intrageneric affinities and geographic origin of this earthworm species, as is the case with most lumbricids, remain uncertain.

A portion of this work was accomplished during the tenure of a Summer Faculty Research Fellowship awarded the writer by the Horace H. Rackham Graduate School of the University of Michigan.

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THE SUPERMARKET TERRACE, NEAR EAST LIVERPOOL, OHIO

HEBER D. LESSIG

Soil Conservation Service, U.S.D.A., Lisbon, Ohio

An excavation for a building housing a supermarket in East End, Ohio, (east part of E. Liverpool) (Wellsville, Ohio, W. Va.-Pa. quadrangle map of the U. S. Geological Survey) uncovered terrace material of sand and gravel, about 25 ft thick, buried beneath a soil formed from colluvium, about 5 to 13 ft thick. Both of these layers of soil material contain pebbles of crystalline rock presumed to have been deposited during the Pleistocene Epoch. This locality is 7 miles south of the Illinoian till sheet boundary (White, 1951, Pl. 1).

The colluvium and the underlying sand and gravel are so deeply weathered that the author believes there is evidence here of a pre-Illinoian glaciation.

The soil morphology was studied to determine part of the Pleistocene history of the upper Ohio Valley.

Topography of the Supermarket Terrace and Physiography of the Vicinity

The Supermarket Terrace is one of several terraces in the upper Ohio Valley (Hubbard, 1954, pp. 365–368; Leverett, 1902, pp. 88–98, 121–125; 1934, pp. 100–102) whose soil morphologies are under study by the author. The Ohio River, about half a mile to the south, is at 656 ft elevation. The flood plain is narrow and discontinuous. North of the river two terrace levels of gravelly alluvium at 720–700 ft and 770–740 ft occupy most of the inner Ohio Valley and underlie East End between the supermarket and the river. The Supermarket Terrace with its southward sloping colluvial surface is spread over a slope, 500 ft wide, at about 850–800 ft elevation. A remnant of a higher terrace stands 1000 ft to the north, at about 960 ft elevation. Ridgetop remnants of the dissected Allegheny Plateau are at 1160 ft in the immediate vicinity.

The Description of the Supermarket Terrace

The Supermarket Terrace occupies a colluvial bench position ranging from 800 ft elevation at the supermarket to about 850 ft elevation 500 ft to the north. The excavation behind the supermarket reveals the following soil morphology:

Profile Description of the Soil of the Supermarket Terrace

Location	The west side of excavation behind supermarket, located in area bounded by Pennsylvania Avenue, Unity Street, Minnesota Street and City Limits, East Liverpool, NW ½ NE ½ Section 12, Liverpool Township, Columbiana Co., Ohio.
Slope:	15% slightly concave, 400 ft from base of steep slope;
Land Form:	Colluvial bench.
Elevation:	820 ft; Relief: 500 ft difference in elevation between river and ridgetops.
Soil Material:	Colluvium underlain by sandy and gravelly glacial outwash.
Drainage:	Moderately well drained class.

(Soil descriptive terminology used below follows usage of the Soil Survey Manual by the Soil Survey Staff), 1951, U.S. Department of Agriculture, Handbook 18, Washington, D.C.)

Depth and Horizon	Profile description (moist colors in Munsel notations)
0–12 in. A_p	Dark grayish brown (10YR 4/2) silt loam; weak very thin platy structure; friable; channers 10% including a few pebbles; very strongly acid; boundary abrupt smooth.
12–20 in. B_1	Brown (9YR4/4) channery loam with thin A_p stains in vertical cracks, weak medium subangular blocky structure; friable; channers 25–50% including a few pebbles; extremely acid; boundary clear smooth.
20–38 in. B_{21}	Dark brown (7.5YR4/4) channery loam with many coarse distinct reddish brown (5YR4/4) and grayish brown (10YR5/2) mottles; grayish brown (10YR5/2) prism faces; weak coarse prismatic structure breaking to moderate medium angular blocky peds; firm; channers 25% including a few pebbles; extremely acid; boundary clear wavy.
38–60 in. B_{22m}	Dark brown (7.5YR4/2) channery fine sandy loam with many fine distinct gray (10YR5/1) and reddish brown (5YR4/4) mottles; grayish brown (10YR5/2) ped faces; weak fragipan breaking to moderate medium angular blocky peds; very firm; channers 25–40% including a few pebbles; very strongly acid; boundary gradual wavy. This horizon is the lower part of the colluvial material at this site. The colluvium ranges to 13 ft thick in excavation. Where this material is thicker than 60 in. it has a yellowish red (5YR4/8) color.
60–84 in. B_{31u}	Strong brown (7.5YR5/6) fine loam with many medium distinct gray (10YR5/1) mottles and black Mn stains; thin gray (10YR5/1) clay ped faces; moderate coarse prismatic structure breaking to moderate fine angular blocky peds; friable; pebbles 7%; extremely acid; boundary clear smooth. This horizon is upper part of glacial outwash material.
84–116 in. B_{32}	Strong brown (7.5YR5/6) loam to clay loam with many coarse distinct grayish brown (10YR5/2) mottles; grayish brown (10YR5/2) silty clay loam prism faces 5 mm thick and thin grayish brown clay ped faces; weak coarse prismatic structure breaking to moderate medium angular blocky peds; firm; pebbles 2%; very strongly acid; boundary clear smooth.
116–144 in. B_{33}	Grayish brown (10YR5/2) fine loam with many coarse prominent strong brown (7.5YR5/6) mottles; thin grayish brown (10YR5/2) ped faces with clay flows ranging to 10 mm thick; moderate coarse angular blocky structure; firm; pebbles 10%; strongly acid; boundary clear smooth.
144–158 in. C_{1u}	Brown (10YR5/3) gravelly fine sandy loam with many coarse distinct strong brown (7.5YR5/6) mottles; single grain; friable; pebbles 60%, pebble count of 1190 pieces:—soft brown oxidized sandstone 41%, oxidized chert 20%, quartz 20%, oxidized quartzite 8%, concretions 4%, siltstone 2%, red quartzite 2%, rotted granite 3%, very strongly acid; boundary abrupt smooth.
158–300 in. D_1	Layers of brown (10YR5/3) and light brownish gray (10YR6/2) gravel, loam and silt loam with strong brown (7.5YR5/6) and yellowish red (5YR4/6)

mottles; single grain; noncoherent; weathered pebbles 10% in the layers of loam; strongly acid in upper part ranging to medium acid in lower part.

300–360 in. D_2 — Grayish brown (10YR5 2) gravelly sandy loam to loamy sand; single grain; noncoherent; pebbles 40%, pebble count of 494 pieces:—fresh gray sandstone 65%, unoxidized shert 10%, unoxidized quartzite 6%, quartz 8%, concretions 6%, siltstone including some possible limestone ghosts 2%, fresh granites and gneiss 2%, hard red quartzite 1%; slightly acid in upper part ranging to neutral in lower part. This horizon is lower part of the glacial outwash.

360 in. + D_4 — Very dark gray, thin bedded siltstone, unweathered at contact with glacial outwash.

TABLE 1

Physical and morphological data of soil and material of Supermarket Terrace*

Depth in inches	Horizon	sand 2–.05 mm	silt .05–.002 mm	total clay .002 mm	fine clay .0002 mm	pH	Thickness of clay skins	Macro structure/ micro structure
0–12	A_p	32	50	18	2	4.4	none	weak very thin platy
12–16	B_1	37	45	18	3	4.3	none	weak medium subangular blocky
16–20	B_1	41	40	19	4	4.3	none	
22–28	B_{21}	43	38	19	4	4.4	none	coarse prismatic/moderate med. angular blocky
32–38		55	29	16	5	4.4		
38–45	B_{22m}	60	23	17	5	4.5	none	fragipan/moderate medium angular blocky
55–60		58	27	16	4	4.6		
60–65	B_{31u}	45	32	24	9	4.4	thin	coarse prismatic/moderate fine angular blocky
80–84		36	38	26	9	4.4		
92–98	B_{32}	33	40	27	8	4.6	5 mm	weak coarse prismatic/ moderate med. angular blocky
110–116		31	42	27	9	5.0		
127–133	B_{33}	31	43	26	8	5.4	1–10 mm	weak coarse angular blocky
144–158	C_{1u}	60	21	19	6	5.2	none	single grain
166–172	D_1	31	51	17	5	5.2		single grain
178–184		48	38	14	4	5.3		
214–218		38	47	15	5	5.2		
248–252		37	49	14	4	5.4		
274–278		32	53	15	5	5.5		
328–332	D_2	57	31	12	3	5.9		single grain
350–360		73	20	7	2	6.8		

*Mechanical analysis made by the Ohio Agricultural Experiment Station, at Columbus, Ohio.

Soils of Other Terraces

Remnants of the high level terrace of the upper Ohio Valley occur about 100 ft higher in elevation and 1000 ft north of the supermarket; in vicinity of Riverview Greenhouse, north $\frac{1}{2}$, Section 18, Liverpool Township; in vicinity of Spring Grove, south $\frac{1}{2}$, Section 36, Liverpool Township; in Hamond Park and Spring hill Cemetery in northeast $\frac{1}{4}$, Section 10, Yellow Creek Township; and in West 18th Street Heights in Wellsville (above Vulcan). The alluvium at these places contains pebbles of crystalline rocks, is presumed to be glacial outwash, and is more deeply weathered than that of the Supermarket Terrace. It is buried by colluvium

near valley walls. The detailed description of the soil morphology of this highest terrace will be reported when the study is completed.

A terrace at 770–740 ft elevation underlies the general area between the supermarket and the Ohio River in East End (Leverett, 1934, pp. 100–102). It is composed of glacial outwash and is much less weathered than the Supermarket Terrace at 850–800 ft.

A lower terrace occurs at 720–700 ft elevation which is comparatively little weathered and contains relatively fresh gravelly glacial outwash near its surface.

The morphologies of the soils of both the 770–740 and 720–700 ft terraces are also under study and will be reported when the study is completed. Little or no colluvium is present on these two lower terraces.

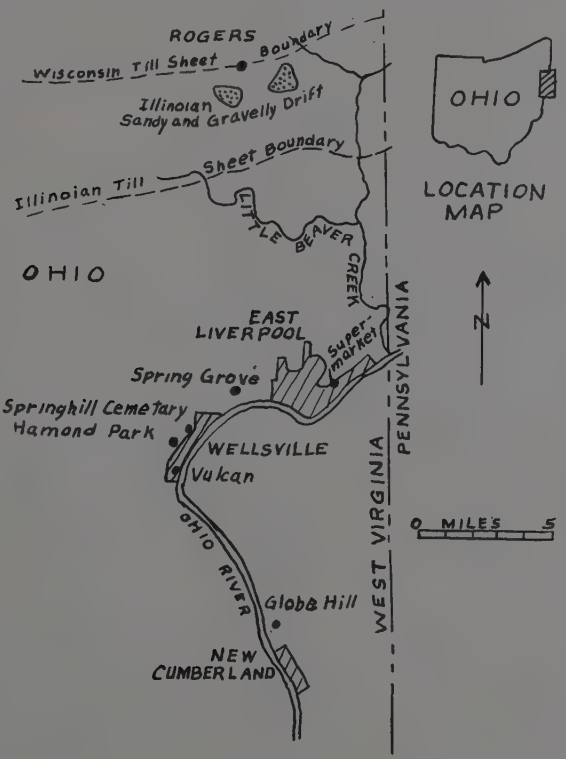

FIGURE 1. Map of the Upper Ohio Valley Near East Liverpool, Ohio.

A colluvial bench, underlain at several places with gravel, extends eastward from the Supermarket Terrace to the state line and is preserved in remnants up Little Beaver Creek at 100–150 ft above stream level. This colluvial bench occupies a similar relative position and elevation to the Supermarket Terrace. While good exposures are lacking and its genesis is uncertain, this colluvial bench possibly belongs to the same geological event as the Supermarket Terrace. The colluvial bench is not found on the Little Beaver tributaries and probably predates the formation of their present entrenched valleys.

A terrace remnant at 860 ft elevation, 1½ miles downstream from the Supermarket Terrace, at the corner of Pennsylvania Avenue and Blakley Streets in East Liverpool, is mantled by a very deeply weathered glacial outwash, over 12 ft thick. The soil on the crest of the remnant is a re-exhumed paleosol juxtaposed to another soil, developed in a less weathered gravelly alluvium, which buries the paleosol on the south side slope of the terrace remnant. The subsoil of the paleosol is a yellowish red sandy clay loam with structure and clay formation extending to an 8 ft depth. The pebbles of granite in the paleosol at an 8 ft depth are rotted so that only their ghosts remain. This degree of weathering and the position of the 860 ft terrace is similar to that of the Supermarket Terrace; however, the soil morphology differs because the 860 ft terrace is somewhat excessively drained and not covered by colluvium. The gravelly alluvium, which buries the paleosol on

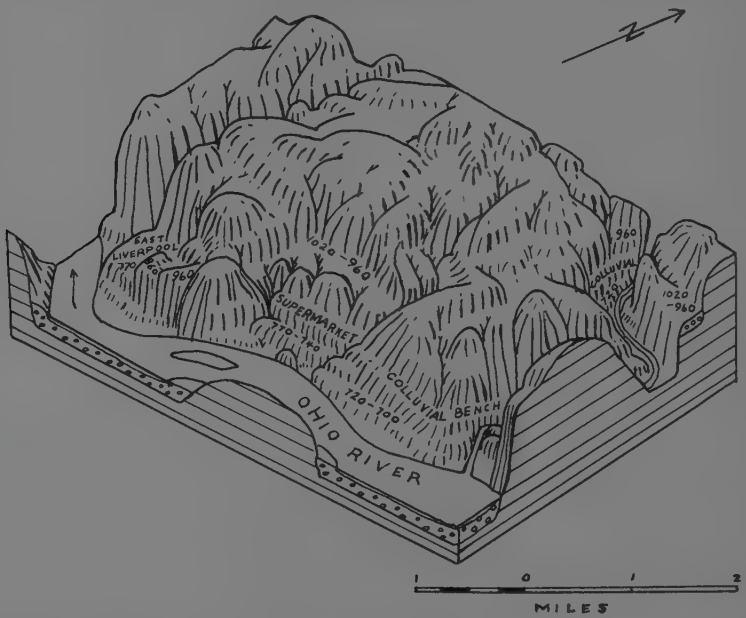

FIGURE 2. Diagram of Landscape in the Vicinity of the Supermarket Terrace. Little Beaver Creek on right. East Liverpool and East End along the river. Village of Grimms Bridge in valley of Little Beaver Creek, in upper right corner. Various terrace levels are designated by elevations or names.

the south sideslope of the terrace, is only a few feet thick where it can be observed and no attempt to interpret it will be made here. It is younger than the outwash in which the paleosol is formed and 90 ft higher than lower, less weathered glacial drift. This must be considered in further studies of various terrace levels in the vicinity.

DISCUSSION

The soil morphology of the Supermarket Terrace is complex because the glacial outwash is buried by 5 to 13 ft of colluvium. This colluvium protected the glacial outwash from some chemical weathering and soil formation.

The author examined the B_{31u} soil horizon (upper part of the glacial outwash) searching for a buried paleosol. No buried A_1 or evidence of an A_2 horizon was found here during field examination. The mechanical analysis (table 1) shows a slight clay accumulation in the lower part of the B_1 and upper part of the B_{21} horizons but not enough to class them as textural B horizons. They can be classed as structural and color B horizons. Clay has accumulated or formed in the B_{31u}, B_{32}, and B_{33} horizons, formed in the glacial outwash.

It is probable that the glacial outwash was buried soon after its deposition because there was not enough time for a soil to form before it was buried by colluvium. Since colluvium is meager or lacking on lower and younger terrace levels, the colluviation apparently occured before the latter were laid down.

Chemical weathering and soil formation extend through the colluvium into the glacial outwash to a 12 ft depth, clay is formed to 25 ft, and carbonates are leached throughout the 30 ft thickness of unconsolidated material. Pebbles of granite are rotted at 13 ft and pebbles of limestone have completely decomposed and are lacking throughout the profile.

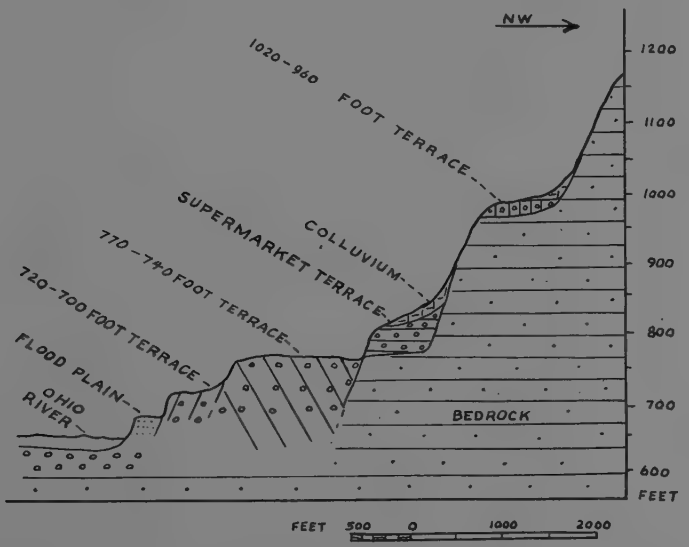

FIGURE 3. Section of North Side of Ohio Valley Near the Supermarket Terrace.

The elevation and weathering of the Supermarket Terrace are similar to those of a gravelly layer mantling part of the terrace at Globe Hill (Lessig, 1959, pp. 48–54), 2½ miles north of New Cumberland, West Virginia, and 15 miles downstream from the Supermarket Terrace; and a terrace in East Liverpool at the corner of Pennsylvania Avenue and Blakley Streets. However, the soil morphologies of these terraces are different because they are formed from a somewhat excessively drained gravel and not buried by colluvium while the soil of the Supermarket Terrace is formed under only moderately well-drained conditions, due to receiving seepage from upper slopes, and is buried by 5 to 13 ft of colluvium.

The soil morphology and the weathering of the material of the Supermarket Terrace indicate a greater age than that of Illinoian sandy-gravelly drift, a few miles to the north, at such places as ¼ mile south of Rogers (White, 1951, p. 970)

and 2 miles east of Rogers at 1130 ft elevation in NW ¼ Section 16, Middleton Township, Columbiana County, Ohio. Illinoian drift at these places is leached to a 15–18 ft depth; granite pebbles have only weathered rinds and solums in sandy loam material are developed to only a 4 to 6 ft depth.

The 770–740 and 720–700 ft terraces underlying East End are parts of two general terrace levels throughout the upper Ohio Valley and along Little Beaver Creek. The soil of the 770–740 ft terrace appears to be similar to the soils of the Illinoian sandy-gravelly drift near Rogers and the soil on the 720–700 ft terrace appears to be still younger. Soils developed on these terraces are being studied at more advantageous locations than in East End and will be reported when their study is completed. Their age is uncertain but younger than the Supermarket Terrace.

The 1020–960 ft terrace, 100 to 160 ft higher and more deeply weathered, is presumed to be older than the Supermarket Terrace.

CONCLUSION

The Supermarket Terrace is similar in weathering and elevation to the terrace at Globe Hill, on the West Virginia side, 12 miles downstream, and a terrace in East Liverpool, 1½ miles downstream although it is mantled with different soil material and has a different soil morphology.

The solum of the Supermarket Terrace is 12 ft thick which is thicker than the solums developed from Illinoian sandy-gravelly glacial outwash a few miles to the north and is older than two other terrace levels at 770–740 and 720–700 ft in the immediate vicinity.

The Supermarket Terrace was deposited during a glacial stage that is older than the Illinoian stage of glaciation but younger than the stage during which the earliest glacial outwash terrace was deposited in the upper Ohio Valley. It apparently belongs to a second stage of glaciation of the Allegheny Plateau.

The glacial outwash material of the Supermarket Terrace was buried by thick colluvium soon enough after glaciation so that there was not enough time for a soil profile to be formed from the glacial outwash before being buried. Such thick colluvium is common to the terrace level of the Supermarket Terrace in the upper Ohio Valley and along Little Beaver Creek.

Correlation of the various terraces in the upper Ohio valley must await completion of studies being conducted on the 1020–960, 760–740 and 720–700 ft terraces and on their relation to drift sheets to the north.

ACKNOWLEDGMENTS

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NEW RECORDS FOR OHIO DRAGONFLIES†
(ODONATA: ANISOPTERA)

ROBERT W. ALRUTZ
Department of Biology, Denison University, Granville, Ohio

Publications concerned with the distribution of the Odonata of Ohio have appeared with some regularity over the past sixty-five years. The earliest of these were included by Borror (1937) in his comprehensive summation of the collections and records for Ohio. Since that date, six other papers have expanded the known distributions to some twelve hundred records for the suborder Anisoptera. These reports, however, obviously do not present a realistic picture of the Ohio dragonfly fauna. With ninety-five species and eighty-eight counties, the potential distributions must be more extensive than those reported. The mean number of counties thus far reported for a species is six (average of 10.43). Conversely, the mean number of species reported for a county is seven (average 11.26). More specifically, only seven counties have more than one-third of the Ohio species reported for them. These seven are quickly identified with specific collectors: Defiance, Paulding, and Williams with Homer F. Price; Erie with James S. Hine, B. Elwood Montgomery, et al.; Logan and Franklin with Donald Borror; and Portage with R. C. Osburn and J. S. Hine. Thus, again published records indicate the distribution of collectors, not of species.

The following new county records increase by twenty percent the records published for the suborder Anisoptera. All of the specimens were collected and identified by the author and are in his collection. The collecting resulting in this report was done incidental to other responsibilities, which took the author into almost one-half of the counties in Ohio during the summer months of 1957 and 1958. Due to the nature of opportunities for collecting, little concentrated effort could be extended towards being comprehensive in any one area or extensive in the types of habitats visited. Therefore, the twenty species in this report are in general those frequenting pools, ponds, lake shores, or roadside ditches.

These records are based upon actual collections; sightings are not included. By this criterion, collections are considered as surplanting previous sightings. Such new records are indicated with an asterisk (*). The number used for each species corresponds to that assigned by Borror (1937) and Price (1958).

List of New County Records

31 *Anax junius* (Drury)
Allen, Athens, Clark, Crawford, Hardin, Highland, Hocking, Jackson*, Knox, Marion, Morrow, Muskingum, Pike*, Preble, Richland, Wood, Wyandot.

36 *Aeschna constricta* Say
Licking

40 *Epicordulia princeps* (Hagen)
Crawford, Jackson, Knox, Morrow, Preble, Scioto.

50 *Tetragoneuria cynosura* (Say)
Scioto

54 *Perithemis tenera* (Say)
Allen, Ashland, Athens, Crawford, Delaware, Fayette, Hardin, Highland, Hocking, Huron, Jackson, Knox, Madison, Marion, Morrow, Muskingum, Perry, Pickaway, Pike, Preble, Richland, Ross, Scioto, Seneca, Union, Wood, Wyandot.

55 *Celithemis elisa* (Hagen)
Athens, Hocking, Knox, Lawrence, Licking, Perry, Pickaway, Wood.

56 *Celithemis eponina* (Drury)
Clark*, Delaware, Hardin, Knox, Morrow, Richland, Wayne.

62 *Libellula cyanea* Fabricius
Athens, Jackson, Scioto.

†This investigation was supported in part by a grant from the Denison University Research Foundation.

64 *Libellula luctuosa* Burmeister
Allen, Athens, Auglaize, Clark*, Crawford, Fayette, Hardin, Highland, Hocking*, Holmes*, Huron, Knox, Lawrence, Morrow, Muskingum, Perry, Pickaway, Preble, Richland, Ross*, Scioto, Seneca, Union, Wyandot.

65 *Plathemis lydia* (Drury)
Allen, Athens, Crawford, Darke, Fayette*, Hardin, Highland, Holmes, Huron, Jackson, Perry, Preble, Richmond, Union, Wyandot.

66 *Libellula pulchella* Drury
Allen, Athens, Auglaize*, Coshocton*, Crawford, Hardin, Highland, Huron, Morrow, Muskingum, Perry, Pike*, Richland, Seneca, Wood, Wyandot.

144 *Sympetrum costiferum* (Hagen)
Knox.

72 *Sympetrum obtrusum* (Hagen)
Huron.

73 *Sympetrum rubicundulum* (Say)
Allen, Ashland, Auglaize, Crawford, Hardin, Holmes, Huron, Knox, Marion, Muskingum, Wyandot.

74 *Sympetrum semicinctum* (Say)
Allen, Crawford, Delaware, Hardin, Holmes, Licking, Marion, Richland.

76 *Sympetrum vicinum* (Hagen)
Huron, Knox, Richland.

78 *Pachydiplax longipennis* (Burmeister)
Allen, Athens, Clark, Crawford, Fayette, Hardin, Highland, Huron, Jackson, Knox, Pike*, Preble, Richland, Ross, Scioto, Seneca, Union, Wyandot.

79 *Erythemis simplicicollis* (Say)
Allen, Clark*, Crawford, Delaware, Hardin, Highland, Hocking, Huron, Jackson, Knox, Lawrence, Marion, Montgomery*, Morrow, Muskingum, Pike, Preble, Richland, Ross, Scioto, Seneca, Union, Wyandot.

82 *Tramea carolina* (Linnaeus)
Hocking, Licking*.

83 *Tramea lacerata* Hagen
Ashland, Athens, Fayette, Hardin, Highland, Hocking*, Huron, Jackson*, Knox, Lawrence, Marion, Morrow, Preble, Richland, Wyandot.

Extensions of Seasonal Range

These collections also contain specimens which extend the seasonal range of three species.

144 *Sympetrum costiferum* (Hagen)
One female collected at a small weedy pond near Centerburg, Ohio (Knox County) on July 12, 1957, radically extends the date of this species in Ohio. The previous dates of September 4 to October 23 were given by Price (1958) for northwestern counties.

72 *Sympetrum obtrusum* (Hagen)
One male of this species collected at Granville, Ohio, October 3, 1957, extends the seasonal range of this species (June 23 to September 27) as published by Borror (1937) and Price (1950).

74 *Sympetrum semicinctum* (Say)
One male of this species collected at Granville, Ohio, on October 5, 1958, extends the seasonal range of this species (July 2—September 21) as given by Borror and Epstein (1942).

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BURIED TOPOGRAPHY AND ITS RELATION TO AN IMPORTANT AQUIFER IN FRANKLIN COUNTY, OHIO†

STANLEY E. NORRIS
U. S. Geological Survey, Columbus, Ohio

In his search for underground reservoirs, the ground-water specialist often must seek clues to the occurrence of aquifers by looking for conditions which in the past were favorable for the deposition of permeable beds. In glaciated regions a study of the buried topography often can provide such clues, leading to the location of buried sand and gravel aquifers. A striking example of the relationship between buried topography and the occurrence of an important aquifer was revealed by an investigation of the ground-water resources of Franklin County, Ohio, made by the U. S. Geological Survey, in cooperation with the Division of Water, Ohio Department of Natural Resources. In eastern Franklin County a buried lowland, developed on beds of soft shale, is a repository for thick and extensive deposits of permeable sand and gravel. The sand and gravel were deposited by glacial meltwaters which were confined to the lowland by abutments formed by more resistant rocks on either side. These permeable deposits compose an aquifer of great potential importance to the Columbus metropolitan area.

The glacial deposits in Franklin County range in thickness from zero, in areas where the bedrock is exposed, to more than 250 feet in buried valleys. A map of the bedrock surface, based largely on records of wells, has revealed two principal erosional surfaces, having dissimilar drainage patterns, whose respective geomorphic stages reflect differences in the resistance of the rocks into which the preglacial streams cut their channels. These erosional surfaces coincide roughly with the western and eastern halves of the county and are developed, respectively, on carbonate rocks of Silurian and Devonian age and on shales of Devonian and Mississippian age (fig. 1).

The buried valleys that formerly drained the shale terrane in the eastern part of the county form a well-integrated dendritic system which drained southward. Prior to Pleistocene glaciation the main stem of this system probably joined the Teays Valley in central Pickaway County, some 10 miles south of Franklin County. The buried valleys in the western part of Franklin County, which were cut into more resistant limestone and dolomite, also drained southward to the Teays Valley. They are not, however, dendritic in pattern but have instead a parallel alinement, suggestive of a trellis drainage system such as might be expected to have developed along the strike of the rocks.

The shale terrane in eastern Franklin County was in the early mature stage of topographic development prior to Pleistocene glaciation. The buried valleys are U-shaped in cross section and the interstream areas, though fairly wide, are characterized mainly by slopes and valley sides. In contrast, the limestone valleys in the western part of the county are narrow and V-shaped, and the bedrock divides are flat and comparatively wide. These features are characteristic of late youth in topographic development. There can be little doubt that both the shale lowland and the limestone upland were subjected to the same cycle of events after the Franklin County area was last uplifted. The shales were lowered more than the limestone because they are softer; for the same reason, the streams that drained the lower land had advanced farther in the erosional cycle. Altitudes on the buried shale upland in Franklin County range generally from about 750 ft in the

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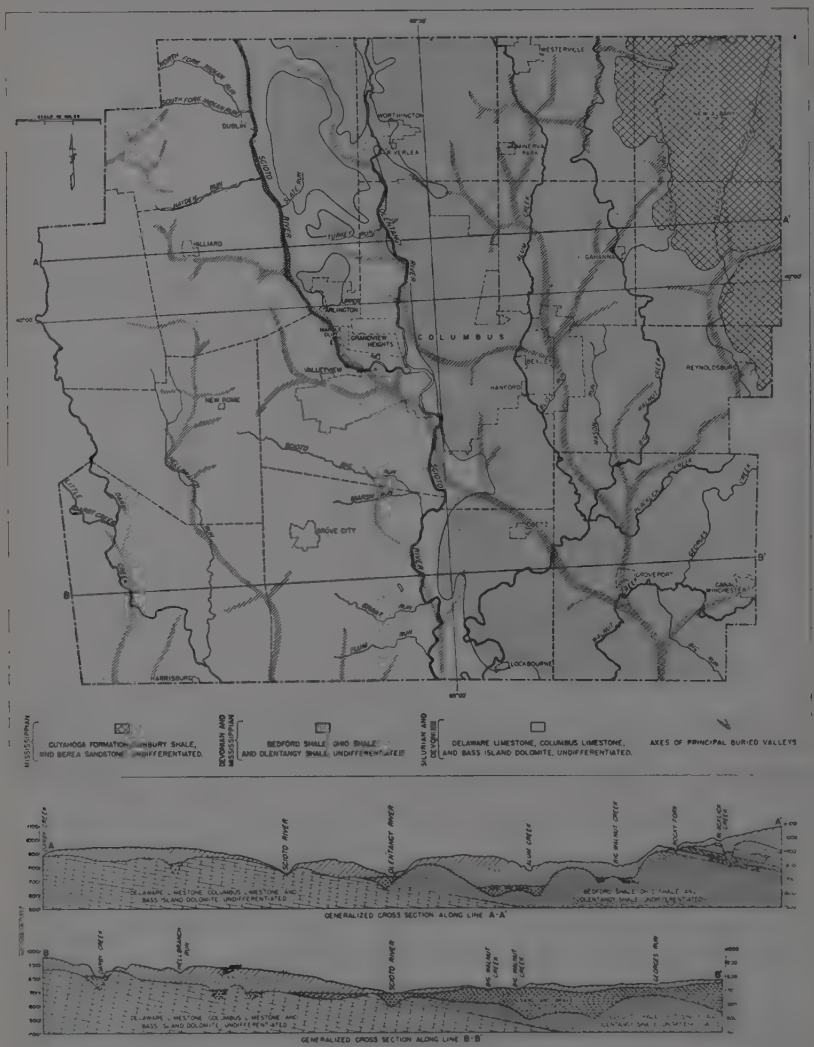

FIGURE 1. Map of Franklin County, Ohio, showing the distribution of the consolidated rocks and axes of the principal buried valleys and geologic cross sections.

south to 850 ft in the north; the altitude of the limestone surface west of the shale terrane ranges from 800 ft in the south to more than 900 ft in the north, and the altitude on the Mississippian rocks near the northeast corner of the county, bounding the shale terrane on the east, is a little more than 1,050 ft. The general level of the shale surface therefore is 50 to 100 ft lower than the limestone upland to the west and as much as 300 ft below the Mississippian rocks in the northeastern part of the county.

Thus, at the beginning of Pleistocene time, the shale terrane in eastern Franklin County stood well below the rocks on either side. This lowland had a profound influence on the distribution of the glacial deposits and, consequently, upon the ground-water resources of the county, for within this lowland were concentrated the meltwaters that poured from the wasting ice during periods of retreat of the glacial front. The meltwaters left extensive deposits of sand and gravel, locally more than 200 ft thick, which underlie at least 100 square miles in southeastern Franklin County and extend southward into adjoining Pickaway County. The sand and gravel deposits in most places represent an outwash plain, but they include areas of kames and eskers. Locally, the deposits are interbedded with thin layers of till. Goldthwait (1958, p. 212) states," . . . these buried esker, kame, and outwash forms surpass anything elsewhere in Ohio glacial drift."

Deposition of the sand and gravel probably began with the aggradation of the pre-Pleistocene valleys and the concentration of deposition at the junctions of the major tributaries. Continued deposition resulted from the spreading of debris-laden melt waters over this initial deposit. The outwash-plain deposits are generally covered by till, except in the valleys of the major streams where locally the till has been removed by postglacial erosion. In areas where the modern streams flow on the sand and gravel deposits, large ground water supplies can be pumped from wells located where they will induce stream infiltration. Ground-water supplies in the magnitude of several million gallons a day are available in the most favorable areas along the streams. Moreover, wells drilled in the buried outwash-plain deposits in areas away from the streams can yield large quantities of ground water from storage. Calculations show that a 12-in.-diameter well, screened in typical sand and gravel deposits that are 150 ft thick and are of large areal extent, can yield one million gallons of water a day (about 700 gallons a minute) for 10 years with a drawdown at the end of the period of only about 6 ft, assuming no recharge. It is clear that large quantities of ground water can be pumped from the outwash-plain deposits. Equally clear is the probability that these deposits will someday become an important source of water to the Columbus metropolitan area. Aquifers having a potential yield equal to that of the buried outwash-plain deposits in Franklin County are uncommon in Ohio. Future water requirements undoubtedly will make it imperative that all such large sources of ground water be located, evaluated, and eventually utilized. A study of the buried topography of the state can aid notably in this task and must be considered an integral part of any comprehensive water-resources investigation.

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THE HUMAN BRAIN AS A PREADAPTIVE FACTOR IN THE DEVELOPMENT OF CULTURE

LEO ESTEL

Department of Sociology and Anthropology, The Ohio State University

The central idea of preadaptation is the development of genetically inherited potentials making possible the utilization of a new environment (Huxley, 1943). The term is quite often used in reference to a set of variables present that make possible survival during drastic climatic changes. A classic example would be the presence of rudimentary lungs and lobed fins in the Crossopterygians of the Palezoic which facilitated the transition of the vertebrates from an aquatic to a terrestial habitat (Romer, 1945). Preadaptation is most probable in a large, highly variable population. The preadapted segment, small in the beginning, expands rapidly, accompanied by wholesale destruction in the rest of the population (Simpson, 1944). Preadaptation does not oppose natural selection but goes along with it, taking advantage of accumulations of small, relatively unimportant mutations.

The known time of man on earth is accompanied by a series of drastic climatic changes during the fluctuation of the glaciations in the Pleistocene. Our earliest evidence for man coincides rather closely with the initiation of the climatic changes leading to the first glaciation (Zeuner, 1946). However, the appearance of drastic climatic changes are not necessary to the application of the idea of preadaptation. A markedly new and different use of an existing environment could be made possible by the gathering together of an accumulation of small mutations in a small breeding group.

Evolutionary differentials may be structural, such as the differences between lobe fins and ray fins which seem initially to have served the same function. Differentials may be of a more functional nature as in the difference in the functioning of gill and lung. A third differential is in the functioning of the brain and the central nervous system. Differential behavior between contemporary ape and contemporary man is mediated by differences in size, proportionate distribution of tissues, and microscopic structure of the brain (Hooton, 1942). Differences in facial structure among apes and man have no great significance, as far as behavioral patterns are concerned. The post cranial structure of an ape such as the chimpanzee would provide no great bar to the enjoyment of modern civilization if a human head was properly attached.

From our fragmentary evidence the major observable differential between early man and his immediate primate ancestors is in behavioral patterns as evidenced by utilization of the environment. Very early in his career man began to manufacture tools in a continuing pattern passed on from one generation to another. He also utilized fire very early in his career. If we could observe the transition from ape to man, gross morphological and functional changes would be minute and almost undetectable. Major detectable differentials would be in behavior mediated by an accumulation of small mutations affecting the complex structure of the primate brain. One of the foremost proponents of the idea of asymetrical evolution was Dr. Hooton (Hooton, 1949). Behavioral patterns would indicate that this first human brain persisted through the early part of human existence, probably for about its first two-thirds. In the meantime the facial and postcranial structure of man was undergoing evolutionary modifications.

A major change in behavioral patterns for man appears in Europe with the arrival of the Mousterian culture and Neandertal man (Boule and Vallois, 1957). Intentional burial with grave offerings among the Neandertal type of men indicate an ability to conceptualize far beyond immediate time and place. This dif-

ference in behavioral pattern is accompanied by an enlargement of the brain case and some redistribution of the proportionate constituents of brain tissue. Variant types of man occur in Asia and Africa contemporary with the European Neandertals (Weidenreich, 1943). These seem to fit into a continuum with the Neandertal as regards brain size and behavior. In gross size the Neandertal brain, as evidenced by available brain cases, falls within the range of variability for modern man (McCown and Keith, 1939). The human brain exhibits a large degree of plasticity without alteration of function. Human heads can be deformed artificially without impairment of mental ability. The shape of the Neandertal brain falls within the range of variability for modern man.

A very large discontinuity in cultural development is shown between the Mousterian and Aurignasian cultures in Europe, accompanied by the disappearance of the classic type of Neandertal and the immigration of *Homo sapiens* (Garrod, 1938). The elaboration of culture exhibited by *Homo sapiens* is made possible, in part, by an apparently greater group organization and cooperation. Neandertal man seems to have been an exponent of rugged individualism operating in very small bands.

The human brain is a very complex organ performing many functions. Only a part of the brain is occupied with the conscious reception of stimuli and its sorting and coordination. The reaction to stimuli are only in part determined by logical reasoning and past experience. Brain size and gross structure for the orangutan, chimpanzee and gorilla show an overlapping continuum. Basic inherited intelligence differs very little among these three groups. The inherited temperamental disposition differs markedly among orangutan, chimpanzee and gorilla (Yerkes and Yerkes, 1929). I believe that these temperamental differentials are mediated by subliminal activity in the mid brain.

As in the case of the transition from ape to man, the major differential between Neandertal man and *Homo sapiens* is in behavioral patterns and not in morphological structure. The facial and post cranial structures of the Mt. Carmel type of Neandertal would be quite compatible with participation in modern culture. As in the case of the anthropoid apes, the major differentials between Neandertal and *Homo sapiens* seem to be in the realm of temperamental disposition, not in intellectual capacity.

Differences between prehistoric skeletal remains of *Homo sapiens* and the skeleton of modern *Homo sapiens* do not exhibit biological differences that would show an evolutionary change as regards intelligence. The cultural elaborations of early *Homo sapiens* indicate a cultural capacity equal to that of modern man. The time of *Homo sapiens* is very short from an evolutiionary standpoint and neither bones nor culture indicate noticeable important evolutionary changes.

I would summarize three stages in culture preceded and made possible by mutations inducing changes in the structure of the brain. First, the change from ape to man making possible the more efficient use of the environment. Second, the change to the Neandertal type of brain with its ability to conceptualize in time and space. Third, the *Homo sapiens* type of brain with the capacity for cultural elaboration. Each one of these stages made possible the new use of an existing environment. From his inception *Homo sapiens* seems to have had the capacity for cultural elaboration mediated more by a change in temperamental disposition than by an increase in intellectual capacity. The *Homo sapiens* brain contains preadapted factors making possible the development of our way of life.

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The Air. *Edgar B. Schieldrop.* Philosophical Library, New York. 1958. 256 pp. $12.00.

This is one of a series of four independent books on the conquest of space and time undertaken by Edgar Schieldrop, a British Professor of Applied Mathematics. It is a nonmathematical and quite nontechnical presentation of flight from the dreams of mythology to the reality of recent years. The emphasis is on flying rather than on flying machines. The viewpoint is that of a competent person writing in a subject area somewhat divorced from his area of special competence. The most technical portion of this book is devoted to an elementary discussion of lift and why it occurs. Many excellent photographs with copious captions are included.

The story of flight from the days of hot air balloons thru exploratory attempts at gliding and crude powered flight up to the time of jet flight is unfolded in a rather interesting and popular manner. The author emphasizes the point that man had to learn to fly or learn adequate means of controlling heavier-than-air machines before he could build a successful one. The evolution of the flying machine although chronologically rapid was accomplished thru the small contributions of many, just as is true of most major developments.

The Air should particularly appeal to lay people and others who are not too intimately associated with aviation although it does provide a quite readable semihistorical presentation for those in the field too.

Garvin L. Von Eschen

Species Plantarum. *Carolus Linnaeus.* A facsimile of the first edition, 1753. Vol. I. Printed for the Ray Society, sold by Bernard Quaritch Ltd., 11 Grafton Street, London W1, 1957. 2 pounds, 10 shillings.

It is not often that a reviewer will call to the attention of readers recent publications of facsimile editions. This volume will be of considerable interest, however, to all biological scientists and science historians. Practicing systematic botanists still refer to Linnaeus' works, although only the few who work in large universities or famous libraries have access to a first edition of *Species Plantarum.* Now, for a reasonable amount of money, scientists working in any part of the world may own and use an excellent copy of this famous book. Its value for today is greatly enhanced by the scholarly 176 pages of Introduction by W. T. Stearn, of the British Museum. He has brought together from many sources, background materials and interpretations bearing on Linnaeus and Linnaeus' contributions to science. This will be of particular interest to the student. Some of the chapters of the Introduction deal with pre-Linnaean literature, a short biography of Linnaeus, a history of Linnaean herbaria, the species-concept of Linnaeus, the sexual system of classification, nomenclatural impact of *Species Plantarum*, geographical names in *Species Plantarum*, and a general bibliography. Each chapter in turn is followed by a list of references. The Introduction is followed by the 560 pages of facsimile which is quite clear and easily read. The final section of the book is an index to genera and classes, with page references to the 5th edition of *Genera Plantarum.*

If the possessor of this volume does nothing but show it to his students, or if he simply reads the Introduction but has no immediate use for the facsimile, he can derive much benefit. Certainly, for the systematic botanist much of the materials of the Introduction are "must" reading. The libraries of smaller universities and colleges will want one because of the prestige of *Species Plantarum.*

To handle this book gives one much the same feeling as owning a rare, old book of tremendous value. Truly, the publication of *Species Plantarum* was one of the most significant events in the whole history of science, and marked the beginnings of modern systematic botany.

Robert W. Long

SONGS OF THE CHIPPING SPARROW

DONALD J. BORROR

Department of Zoology and Entomology, Ohio State University, Columbus 10

Songs of the Chipping Sparrow (*Spizella passerina*) have been described (Saunders, 1935, p. 263; Peterson, 1947, p. 235) as a simple trill or rapid series of notes, all on one pitch, and of a dull and unmusical quality. The only variations mentioned are in speed ("fast" or "slow") and in the number of notes in the song. The notes of the song are generally uttered too rapidly to count, but Saunders believed their number was usually a multiple of eight; Brand and Axtell (1938) found variations of 11 to 52 in the number of notes in thirteen songs recorded on sound film. Apparently nothing is known of the detailed character of the individual notes and their variation in different songs.

This paper is based on a study of 58 Chipping Sparrow recordings in the collection of tape recordings of the Laboratory for the Study of Animal Sounds, Department of Zoology and Entomology, Ohio State University. These recordings (see table 1) include 39 from Ohio, 12 from Maine, three from West Virginia, three from Pennsylvania, and one from Michigan, and contain a total of 461 songs. Four of the Ohio recordings (the first four listed in table 1) were made with a Brush Soundmirror recorder using a tape speed of seven and one-half inches per second; the remainder were made with a Magnemite, Model 610–E, using a tape speed of 15 inches per second. All were made by the writer (a few with the assistance of Dr. Carl R. Reese). These recordings have been analyzed with a Vibralyzer (Borror and Reese, 1953), and graphs made of the different patterns found. The number of notes or phrases in each song have been counted by playing the tapes at a reduced speed.

The graphs show that the songs of this species are not as simple as the published descriptions would lead one to believe, and that there is a considerable amount of variation in the songs of different birds.

Characteristics of Chipping Sparrow Songs

Chipping Sparrow songs are trills. A trill is a series of similar notes or phrases uttered too fast to count (more than six per second), up to about 30 per second. If similar notes or phrases are uttered faster than about 30 per second they sound buzzy. If a note is fluctuated up and down in pitch at rates exceeding about 30 per second, we describe it as being buzzy in quality. A simple trill is one in which all the phrases are alike (or, the first and/or last phrase may be incomplete); a two-parted trill contains a series of phrases of one type, then a series of phrases of another type. Chipping Sparrow songs are generally simple trills; only one song in the 461 studied was a two-parted trill.

The individual phrases of the song contain from one to three slurred notes (fig. 1–41). The slurring is usually quite rapid, in some cases over an octave or more in 0.01 second; it is this rapid slurring of the notes that gives the song its dull and unmusical quality. The notes are usually clear, but in a few songs (fig. 1–4) each phrase contains a buzzy note. The notes may be up-slurred or down-slurred (or both); the phrases in most songs contain both up-slurred and down-slurred elements.

Several characteristics of the recorded songs studied are summarized in table 2; the calculations were run using more decimal places than are given in this table. The phrase length includes the length of the notes in the phrase, plus the silent interval between the notes of successive phrases; this was calculated from the graphs as the average length in about a second of the song. Very little variation, never more than a few thousandths of a second, was found in the length of different

TABLE 1

Chipping Sparrow recordings studied

No. of Recording	Locality	Date	No. of Songs
84	Sugar Grove, Ohio	May 28, 1948	10
113	Columbus, Ohio	April 26, 1949	22
166	Worthington, Ohio	May 3, 1950	29
273	Columbus, Ohio	April 9, 1952	10
372	Columbus, Ohio	April 5, 1953	5
413	Worthington, Ohio	April 18, 1953	4
414	Columbus, Ohio	April 25, 1953	9
508	Lakeside, Ohio	May 17, 1953	6
608	Lincoln Co., Me.	July 20, 1953	14
666	Worthington, Ohio	May 30, 1953	4
797	Worthington, Ohio	April 30, 1954	14
799	Worthington, Ohio	April 30, 1954	5
952	Worthington, Ohio	May 2, 1954	7
953	Worthington, Ohio	May 2, 1954	8
954	Worthington, Ohio	May 2, 1954	9
986	Columbus, Ohio	May 9, 1954	7
1013	Lancaster, Ohio	May 14, 1954	11
1298	Columbus, Ohio	April 14, 1955	9
1306	Zaleski, Ohio	April 16, 1955	7
1482B	Lincoln Co., Me.	June 14, 1955	2
1527B	Lincoln Co., Me.	July 7, 1955	12
1686	New Albany, Ohio	April 13, 1956	9
1702	University Park, Pa.	April 18, 1956	4
1703	University Park, Pa.	April 18, 1956	4
1705	University Park, Pa.	April 18, 1956	3
1718	New Albany, Ohio	April 27, 1956	6
1719	New Albany, Ohio	April 27, 1956	8
1746	New Albany, Ohio	April 29, 1956	8
1770	New Albany, Ohio	May 3, 1956	10
1974	Adams Co., Ohio	June 2, 1956	8
1980	Adams Co., Ohio	June 2, 1956	6
2045	Lincoln Co., Me.	June 16, 1956	4
2053	Lincoln Co., Me.	June 20, 1956	6
2064	Lincoln Co., Me.	June 20, 1956	8
2223	Lincoln Co., Me.	July 28, 1956	13
2477	New Albany, Ohio	April 27, 1957	8
2643	Westerville, Ohio	May 15, 1957	3
2645	New Albany, Ohio	May 15, 1957	1
2760	Oscoda Co., Mich.	May 30, 1957	8
2819	Hocking Co., Ohio	June 2, 1957	7
2997	Lincoln Co., Me.	July 14, 1957	5
2998	Lincoln Co., Me.	July 14, 1957	10
3017	Jefferson, Me.	July 21, 1957	9
3244	Columbus, Ohio	April 20, 1958	11
3248	Columbus, Ohio	April 20, 1958	1
3249	Columbus, Ohio	April 20, 1958	9
3250	Columbus, Ohio	April 23, 1958	4
3251	Columbus, Ohio	April 23, 1958	6
3263	Wheeling, W. Va.	April 25, 1958	2
3268	Wheeling, W. Va.	April 25, 1958	8
3279	Wheeling, W. Va.	April 26, 1958	7
3287	New Albany, Ohio	April 30, 1958	8
3299	New Albany, Ohio	April 30, 1958	10
3303	Reynoldsburg, Ohio	May 1, 1958	6
3328	Worthington, Ohio	May 7, 1958	6
3381	Highland Co., Ohio	May 11, 1958	7
3529	Wiscasset, Me.	June 28, 1958	10
3663	Lincoln Co., Me.	July 29, 1958	13

TABLE 2

Characteristics of Chipping Sparrow songs

No. of Recording	Song Pattern Patt. No.	Song Pattern Fig.* No.	No. of Phrases Range	No. of Phrases Average	Silent Interval Between Phrases (sec.)	Song Length (sec.) Range	Song Length (sec.) Average	Phrase Length (sec.)	Phrases per Second
84	5	(7)	42–58	50.50	0.040	2.61–3.61	3.14	0.063	15.9
113	25	(38)	15–32	24.32	0.040	1.64–3.55	2.68	0.112	8.9
166	25	(38)	17–24	21.28	0.044	1.67–2.38	2.10	0.101	9.9
273	14	(23)	32–46	41.60	0.030	1.76–2.54	2.29	0.056	17.9
372	16	(25)	26–29	27.60	0.027	2.55–2.85	2.71	0.099	10.1
413	19	(30)	37–47	44.25	0.022	2.13–2.71	2.55	0.058	17.2
414	16	(25)	26–31	28.67	0.014	2.36–2.82	2.60	0.091	11.0
508	21	32	29–35	31.67	0.029	2.32–2.80	2.53	0.081	12.4
608	4	6	50–61	55.57	0.016	2.47–3.02	2.75	0.050	20.1
666	17	26	20–29	24.25	0.026	2.17–3.15	2.63	0.110	9.1
797	7	9	36–71	51.71	0.027	2.50–4.95	3.60	0.070	14.3
799	4	5	57–63	58.80	0.021	2.51–2.78	2.59	0.044	22.5
952	17	(26)	23–33	27.14	0.026	2.46–3.55	2.91	0.108	9.2
953	10	16	25–29	27.00	0.025	1.77–2.06	1.92	0.072	13.9
954	19	30	47–72	53.00	0.025	2.70–4.14	3.04	0.058	17.3
986	11	17	13–18	14.57	0.063	1.82–2.54	2.04	0.145	6.9
1013	2	(3)	14–63	32.45	0.020	1.06–4.88	2.50	0.078	12.8
1298	10	12	17–23	20.78	0.030	1.74–2.36	2.13	0.104	9.6
1306	10	(12)	26–32	29.00	0.024	2.45–3.02	2.74	0.095	10.5
1482B	1	1	63–70	66.50	0.026	3.10–3.45	3.28	0.050	20.1
1527B	16	25	22–27	23.58	0.030	2.03–2.49	2.17	0.093	10.7
1686	12	20	18–23	21.11	0.029	1.83–2.35	2.15	0.103	9.7
1702	23	36	13–28	21.50	0.022	1.25–2.71	2.07	0.098	10.3
1703	9	(11)	10–22	16.40	0.046	1.25–2.81	2.08	0.130	7.7
1705	9	11	17–23	20.00	0.042	2.10–2.86	2.48	0.126	7.9
1718	18	29	11–21	18.00	0.031	1.54–2.97	2.54	0.143	7.0
1719	26	39	33–39	35.00	0.022	1.88–2.22	1.99	0.057	17.4
1746	22	(33)	21–53	33.38	0.025	1.29–3.28	2.06	0.062	16.0
1770	22	33	20–31	28.10	0.026	1.22–1.91	1.73	0.063	15.9
1974	25	38	33–47	40.00	0.025	2.47–3.52	2.99	0.075	13.3
1980	22	34	42–49	45.67	0.023	2.51–2.93	2.73	0.060	16.6
2045	18	(28)	20–28	25.25	0.031	2.66–3.74	3.37	0.135	7.4
2053	14	22	28–53	43.83	0.025	1.55–2.95	2.44	0.056	17.8
2064	18	28	24–35	28.00	0.028	3.21–4.69	3.75	0.135	7.4
2223	24	37	21–39	32.00	0.026	1.54–2.89	2.36	0.075	13.4
2477	15	24	40–55	46.63	0.021	2.80–3.86	3.27	0.071	14.2
2643	17	(26)	19–21	20.00	0.011	1.77–1.96	1.86	0.094	10.7
2645	8	10	66	66.00	0.032	6.86	6.86	0.104	9.6
2760	13	21	35–53	46.13	0.021	1.95–2.96	2.57	0.056	17.8
2819	10	(15)	20–30	24.00	0.037	2.04–3.09	2.46	0.104	9.6
2997	17	27	19–29	22.00	0.035	2.17–3.34	2.52	0.116	8.6
2998	10	15	9–37	24.40	0.035	0.94–3.65	2.61	0.108	9.2
3017	2	3	27–36	32.33	0.056	2.05–2.76	2.47	0.078	12.8
3244	10	14	20–23	21.50	0.030	1.74–2.01	1.88	0.089	11.3
					0.045			0.116	8.6
3248	28	41	4+30†	34.00		2.36	2.36		
					0.025			0.064	15.6
3249	11	18	18–27	21.22	0.040	2.10–3.17	2.49	0.119	8.4
3250	20	31	19–24	22.00	0.030	1.87–2.37	2.17	0.100	10.0
3251	10	(13)	22–27	24.00	0.030	2.30–2.83	2.51	0.106	9.4
3263	6	8	16–24	20.00	0.070	1.72–2.62	2.17	0.112	8.9
3268	27	40	21–26	23.25	0.030	2.10–2.61	2.33	0.102	9.9
3279	12	19	26–31	28.29	0.035	2.37–2.84	2.59	0.093	10.8
3287	1	2	45–54	49.88	0.026	2.24–2.69	2.48	0.050	19.9
3299	22	35	36–60	50.00	0.025	2.10–3.51	2.93	0.059	16.9

TABLE 2—(*Continued*)

No. of Recording	Song Pattern Patt. No.	Song Pattern Fig.* No.	No. of Phrases Range	No. of Phrases Average	Silent Interval Between Phrases (sec.)	Song Length (sec.) Range	Song Length (sec.) Average	Phrase Length (sec.)	Phrases per Second
3303	5	7	37–40	38.67	0.030	2.06–2.23	2.16	0.057	17.7
3328	14	23	40–50	45.17	0.026	1.99–2.49	2.25	0.050	19.9
3381	10	13	33–52	39.00	0.030	2.84–4.49	3.36	0.087	11.5
3529	3	4	26–28	27.10	0.030	2.54–2.74	2.65	0.099	10.1
3663	14	(22)	27–61	44.54	0.030	1.59–3.63	2.64	0.060	16.7
All Recordings¶			9–72	33.31	0.030	0.94–6.86	2.61	0.087	11.5 ‡

*Numbers in parentheses represent figures showing the pattern in the recording, but were made from a song in another recording.

†The one song in this recording was two-parted, with 4 phrases in the first part and 30 phrases in the second part; the phrases in the first part were longer than those in the second part.

¶The averages are based on the averages of the 58 recordings.

‡The figure of 11.5 phrases per second is based on an average phrase length of 0.087 sec.

phrases in the same song. Song length was calculated by multiplying one less than the number of phrases by the phrase length, and adding the length of the notes in the last phrase.

Number of phrases. The number of phrases in the songs studied varied from 9 to 72, and averaged 33.31. A few songs whose phrases were two- or three-noted had the last phrase incomplete. The number of phrases in the 461 songs is shown graphically in figure 42; in preparing this figure a partial final phrase was counted as a complete phrase. Neither these counts nor those of Brand and Axtell (op. cit.) support Saunders' contention that the number of notes in Chipping Sparrow songs is usually a multiple of eight.

Phrase length and rate.—The phrase length, measured from the beginning of one phrase to the beginning of the next, varied from 0.044 to 0.145 (average, 0.087) second; this corresponds to a variation in rate of from 22.5 to 6.9 (average, 11.5) phrases per second. The silent interval between the notes of successive phrases varied from 0.011 to 0.070 (average, 0.030) second, and made up from 11.74 to 71.72 (average, 34.68) percent of the total phrase length. In general, the shorter the phrases the more phrases there were in the song.

Song length.—The songs varied in length from 0.94 to 6.86 (average, 2.61) seconds.

Song patterns.—Since the phrases of a Chipping Sparrow song are generally all alike, the variations in different songs may best be classified on the basis of the character of the individual phrases of the song. The differences between songs are such that the delimiting of patterns is somewhat arbitrary, but the songs appeared to me to represent some 28 patterns, in eight principal groups:

A. The song a simple trill
  a. The phrases buzzy in quality
    I. The phrases 1-noted
      Pattern 1, figures 1–2
    II. The phrases 2-noted
      Pattern 2, figure 3
      Pattern 3, figure 4

b. The phrases not buzzy in quality

III. Each phrase a down-slurred note
Pattern 4, figures 5–6
Pattern 5, figure 7
Pattern 6, figure 8

IV. Each phrase a down-slur followed by an up-slur
Pattern 7, figure 9
Pattern 8, figure 10
Pattern 9, figure 11
Pattern 10, figures 12–16
Pattern 11, figures 17–18
Pattern 12, figures 19–20
Pattern 13, figure 21
Pattern 14, figures 22–23

V. Each phrase a single note consisting of an up-slur, a down-slur, and an up-slur
Pattern 15, figure 24

VI. Each phrase beginning with an up-slur, the rest of the phrase down-slurred to a pitch lower than the lowest pitch in the initial up-slur
Pattern 16, figure 25
Pattern 17, figures 26–27
Pattern 18, figures 28–29
Pattern 19, figure 30
Pattern 20, figure 31
Pattern 21, figure 32
Pattern 22, figures 33–35
Pattern 23, figure 36
Pattern 24, figure 37
Pattern 25, figure 38

VII. Each phrase an up-slur over an octave or more, then a down-slur over about half an octave
Pattern 26, figure 39
Pattern 27, figure 40

B. The song a two-parted trill, the phrases not buzzy in quality

VIII. Each phrase type containing an up-slur and a down-slur, the second part phrases shorter
Pattern 28, figure 41

Each recording studied contained songs of only one pattern, and I have never observed a Chipping Sparrow change its song pattern during a period of singing. Two facts from this study suggest, however, that a given individual *may* sing songs of more than one pattern: (1) one pattern (No. 28, fig. 41, recording 3248) contained phrases of two different types; (2) two of the recordings, No. 2053 (pattern 14, fig. 22) and No. 2064 (pattern 18, fig. 28) were made in the same place and only a few hours apart, and are probably of the same bird.

Fifteen of the 28 patterns found occurred in more than one recording (the two recordings containing songs of pattern 9, Nos. 1703 and 1705, are probably of the same bird). Most of these 15 patterns occurred in recordings from different localities, and nine of them occurred in recordings from different states. The pattern found in the most recordings (pattern 10) was from five areas in Ohio and one area in Maine. Eight of the ten patterns occurring in the Maine recordings occurred also in the Ohio recordings, and one of the three patterns in the West Virginia recordings occurred also in the Ohio recordings.

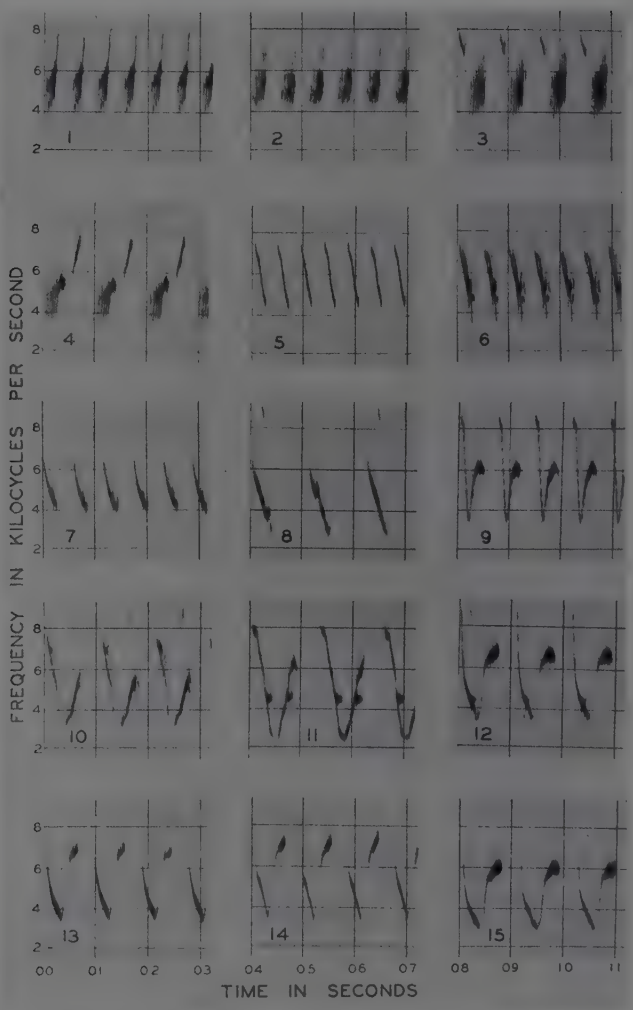

PLATE I, FIGURES 1–15. Audiospectrographs of portions of Chipping Sparrow songs. **1,** pattern 1 (1482B, Lincoln Co., Me.). **2,** pattern 1 (3287, New Albany, Ohio). **3,** pattern 2 (3017, Jefferson, Me.). **4,** pattern 3 (3529, Wiscasset, Me.). **5,** pattern 4 (799, Worthington, Ohio). **6,** pattern 4 (608, Lincoln Co., Me.). **7,** pattern 5 (3303, Reynoldsburg, Ohio). **8,** pattern 6 (3263, Wheeling, W. Va.). **9,** pattern 7 (797, Worthington, Ohio). **10,** pattern 8 (2645, New Albany, Ohio). **11,** pattern 9 (1705, University Park, Pa.). **12,** pattern 10 (1298, Columbus, Ohio). **13,** pattern 10 (3381, Highland Co., Ohio). **14,** pattern 10 (3244, Columbus, Ohio). **15,** pattern 10 (2998, Lincoln Co., Me.).

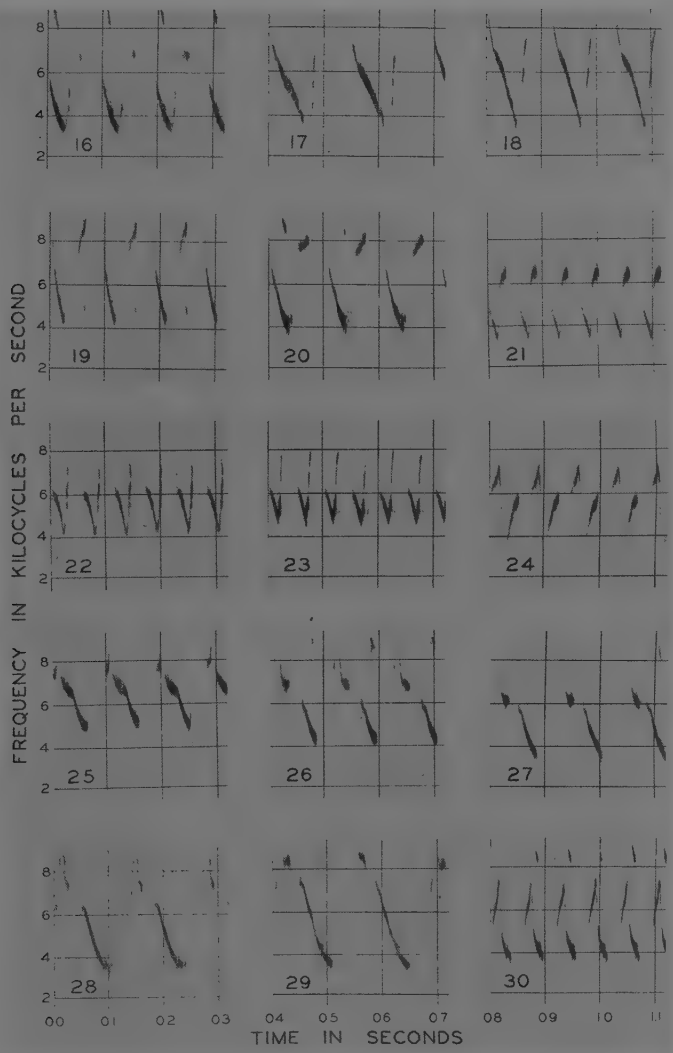

PLATE II, FIGURES 16–30. Audiospectrographs of portions of Chipping Sparrow songs. **16,** pattern 10 (953, Worthington, Ohio). **17,** pattern 11 (986, Columbus, Ohio). **18,** pattern 11 (3249, Columbus, Ohio). **19,** pattern 12 (3279, Wheeling, W. Va.). **20,** pattern 12 (1686, New Albany, Ohio). **21,** pattern 13 (2760, Oscoda Co., Mich.). **22,** pattern 14 (2053, Lincoln Co., Me.). **23,** pattern 14 (3328, Worthington, Ohio). **24,** pattern 15 (2477, New Albany, Ohio). **25,** pattern 16 (1527B, Lincoln Co., Me.). **26,** pattern 17 (666, Worthington, Ohio). **27,** pattern 17 (2997, Lincoln Co., Me.). **28,** pattern 18 (2064, Lincoln Co., Me.). **29,** pattern 18 (1718, New Albany, Ohio). **30,** pattern 19 (954, Worthington, Ohio).

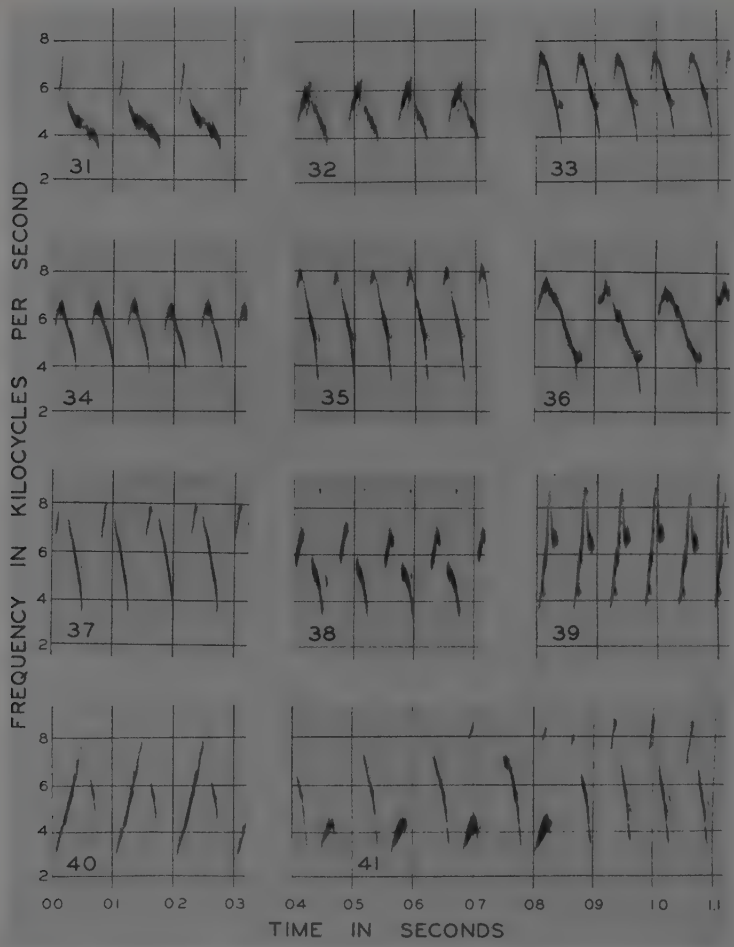

PLATE III, FIGURES 31–41. Audispectrographs of portions of Chipping Sparrow songs. **31,** pattern 20 (3250, Columbus, Ohio). **32,** pattern 21 (508, Lakeside, Ohio). **33,** pattern 22 (1770, New Albany, Ohio). **34,** pattern 22 (1980, Adams Co., Ohio). **35,** pattern 22 (3299, New Albany, Ohio). **36,** pattern 23 (1702, University Park, Pa.). **37,** pattern 24 (2223, Lincoln Co., Me.). **38,** pattern 25 (1974, Adams Co., Ohio). **39,** pattern 26 (1719, New Albany, Ohio). **40,** pattern 27 (3268, Wheeling, W. Va.). **41,** pattern 28 (3248, Columbus, Ohio, about the first third of the song).

Songs of a given pattern sung by different birds usually showed slight differences in the character and length of the phrases; several examples of the variation found within a pattern are shown in the figures (for example, fig. 1 and 2 of pattern 1. fig. 5 and 6 of pattern 4, and fig. 12-16 of pattern 10). Songs of a given pattern sung by different birds usually differed in phrase rate, sometimes by a considerable amount; for example, the phrase rate in the eight recordings of pattern 10 was as follows:

No. 953 (Worthington, Ohio)—13.9 phrases per second
No. 1298 (Columbus, Ohio)—9.6 phrases per second
No. 1306 (Zaleski, Ohio)—10.5 phrases per second
No. 2819 (Hocking Co., Ohio)—9.6 phrases per second
No. 2998 (Lincoln Co., Maine)—9.2 phrases per second
No. 3244 (Columbus, Ohio)—11.3 phrases per second
No. 3251 (Columbus, Ohio)—9.4 phrases per second
No. 3381 (Highland Co., Ohio)—11.5 phrases per second

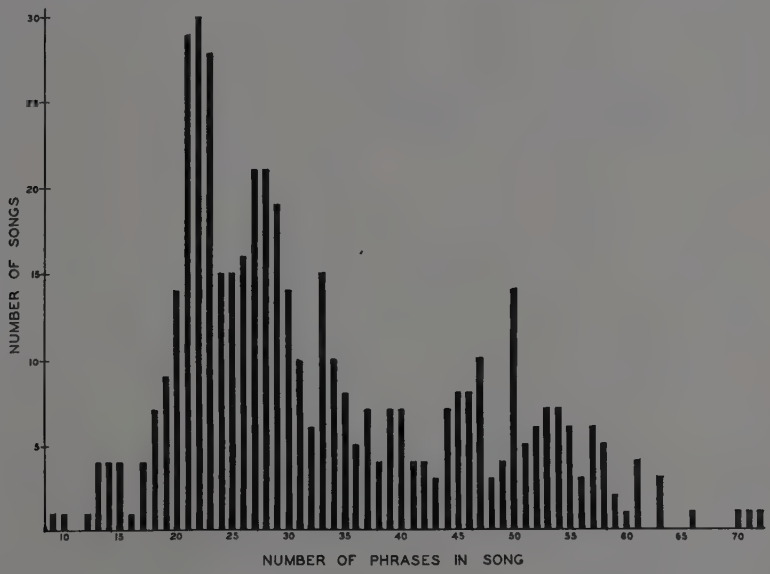

FIGURE 42. Graph showing the number of phrases in the 461 songs studied.

The differences between Maine and Ohio songs of the same pattern were no greater than the differences between different Ohio recordings of the same pattern. There was no evidence in the recordings studied of any significant geographic variation in song pattern in this species.

Frequencies.—The frequencies in most songs ranged from 3000 or 4000 to 7000 or 8000 cycles per second, which means that they were principally in the octave just above the upper limit of the piano range. The extremes of frequency in the 58 recordings were 2000 and 9000 cycles per second. The pitch range in a given song was at least an octave, and in a few songs was as much as two octaves.

Summary

This paper is based on an audiospectrographic analysis of 58 tape recordings of Chipping Sparrow songs; the recordings were from five states and contained

461 songs. Graphs of the songs showed that the notes are not of a uniform pitch, as previously published accounts indicate, but are slurred; the slurring is usually very abrupt, in some cases over an octave or more in 0.01 second. It is this abrupt slurring of the notes that gives the songs their dull and unmusical quality. The songs were simple trills (rarely a two-parted trill) containing 9–72 phrases uttered at rates of 6.9 22.5 phrases per second; each phrase contained from one to three notes. The songs varied in length from 0.94 to 6.86 seconds, and ranged in frequency from 2000 to 9000 cycles per second. The songs were classified in 28 patterns on the basis of the character of the individual phrases, and the patterns in eight groups; each pattern is illustrated by one or more audiospectrographs. Each recording contained songs of only one pattern, but it is possible that a given bird may sing songs of more than one pattern. Fourteen of the 28 patterns occurred in the songs of different birds, and nine of them in the songs of birds in different states. There was no evidence of any significant geographic variation in song pattern in this species.

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TWO NEW SPECIES OF *AGRIOTES* (COLEOPTERA: ELATERIDAE)

JOSEF N. KNULL

Department of Zoology and Entomology, The Ohio State University, Columbus 10

The two following species of *Agriotes* are unlike any forms described.

Agriotes rufohumeralis n. sp.

Male.—Slender, elongate; color very dark brown, prothorax, antennae, an elongate area on each elytron extending from humeral angle to middle, and legs reddish brown, abdomen darker than prosternum.

Head convex, frontal carina directed downward toward labrum; surface densely, finely, umbilicately punctate; antenna extending over three segments beyond hind angles of pronotum when laid along side, ratio of lengths of segments 1 to 11, 2.6:1:1:2.2:2.2.2.1:2.2.2.2.2.2 2.2:2.6. Pubescence short, dense.

Pronotum much longer than wide, widest across hind angles; sides rounded in front, constricted back of middle, widened toward prolonged, acute hind angles; side margin joining anterior edge at prosternal suture, outer edge of suture slightly raised; disk convex without prehumeral carinae; surface densely, minutely umbilicately punctate. Scutellum about as long as broad.

Elytra at base not as wide as base of pronotum, widest back of middle; sides subparallel, broadly rounded on apical third toward sutural margins; disk convex; surface finely striate, punctures of striae small, interspaces minutely punctate.

Abdomen beneath finely, densely punctate. Posterior coxal plate dilated internally. First segment of posterior tarsus longer than three following segments together, fourth segment very small.

Length 5.2 mm; width 1.4 mm.

Holotype male and one male paratype labeled Washington Co., Arkansas, March 20, 1938, in collection of author.

This species does not fit any of the groups designated by Becker (1956), either by external characters, or by male genitalia.

Agriotes caecus n. sp.

Male.—Short, rather robust; dorsal surface very dark brown, lighter beneath, antennae and legs light brown; densely clothed with recumbent golden pubescence on both surfaces.

Head convex, front marginal carina directed downward toward labrum; surface densely, finely punctate; antennae when laid along side not nearly extending to hind angles of pronotum, segments 4 to 10 inclusive serrate, slightly longer than wide, ratio of lengths of segments 1 to 11, 3:1.6:1.6:1.6:1.4:1.6:1.6:1.6:1.6:1.6:2.4.

Pronotum longer than wide, widest across hind angles, much wider at base than at apex; sides rounded on apical quarter, slightly diverging toward hind angles, which are slightly divergent, apices truncate; lateral margin sinuate anteriorly, joining anterior edge at prosternal suture, prosternal suture strongly excavated in front; disc convex, a well-marked oblique prehumeral carina each side, slight median depression on basal third, basal depression on inside of each prehumeral carina; surface densely, finely umbilicately punctate. Scutellum about as long as broad, surface minutely punctate.

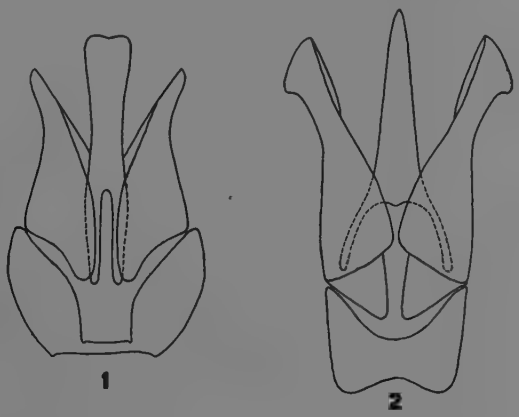

FIGURE 1. *Agriotes rufohumeralis* n. sp., male genitalia.
FIGURE 2. *Agriotes caecus* n. sp., male genitalia.

Elytra at base slightly narrower than base of pronotum, widest back of middle; sides subparallel back of base, broadly rounded back of middle to suture; disk convex; surface striate, punctures small and within striae, interspaces finely rugose, punctures minute.

Abdomen beneath densely, finely punctate, punctures forming rugae. Posterior coxal plate suddenly widened internally. First segment of posterior tarsus shorter than two following segments together.

Length 7.4 mm; width 2.3 mm.

Described from one male holotype collected in Delaware Co., Ohio, May 4, 1944 by D. J. and J. N. Knull in collection of author.

According to Becker (1956) this species runs to the Limosus group. Superficially it resembles *A. avulsus* (Lec.), however it is less shining, head and pronotum are more finely punctured, striae of elytra are deeper, punctures are smaller and within the striae, interspaces are rugose. Male genitalia are also different, apex of lateral lobe not notched.

I am indebted to M. C. Lane for examination of material, and comments.

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BEHAVIORAL AND ELECTRICAL RESPONSES ASSOCIATED WITH EXPOSURE TO EXTREME COLD OR HEAT IN THE SALAMANDER[1]

JOSEPH J. PETERS, ALPHONSE R. VONDERAHE, CHARLES J. CUSICK AND ALVIN A. HUESMAN

Albers Biological Laboratory, Xavier University, and *the Department of Anatomy, College of Medicine, University of Cincinnati, Cincinnati, Ohio*

In order to obtain a clearer understanding of the influence of extremes of temperature on the responsiveness of organisms, the present study applied a series of neurological tests to salamanders exposed to extremes of cold or heat. These tests have been employed successfully to investigate the action of drugs on the nervous and muscular systems of salamanders (Peters, Vonderahe, and Palmisano, 1956; Peters, Vonderahe, and Powers, 1958). They yield information about patterns of behavior, reactions to stimuli, the function of definite tracts and reflex arcs, and electrical activity. Even in a motionless animal, recordings of electrical activity provide clues to the alertness of the animal, condition of nervous and muscular systems, and the frequency and regularity of the heart beat. The salamander, *Triturus viridescens*, was selected for this experiment because it is poikilothermous and does not undergo hibernation; at moderate temperatures it is active and responds readily to a variety of stimuli; and finally the careful studies of Coghill (1930) and Herrick (1948) are available for correlation of its anatomy and behavior.

MATERIALS AND METHODS

About 100 salamanders, the aquatic phase of *Triturus viridescens*, were used for the present study. The animals were maintained for one or more days at a temperature of 24±1° C, then subjected to high or low temperatures of 44° or 0° C. Tele-Thermometers (Yellow Spring Instrument Co.) equipped with hypodermic and other types of small probes were used for measuring temperatures, both internal and external, with an accuracy of plus or minus one degree C. A moist chamber containing the salamander was suspended in an incubator wherein the temperature was changed from 24 to 44° C by a surrounding heating coil and a variable Powerstat transformer. Lower temperatures were achieved by lowering or raising the moist chamber in a larger container immersed in a frozen 10 percent NaCl solution. The salamanders were kept at the extreme temperatures for 30 minutes. However, to avoid excessively sudden changes, 30 minutes were consumed in making the gradual transition from 24° C to either extreme of temperature, and another 30 minutes allowed for the return to 24° C. At approximately 10 minute intervals during the transitional periods, and at the end of 30 minutes of exposure to 44 or 0° C, the salamanders were given a series of neurological tests. These neurological tests involved walking, righting, corneal and abdominal reflexes, optokinetic nystagmus, response to touch, recording of electrical activity of the neuromuscular systems and heart beat, and reaction to the stimulant, Metrazol (Peters, Vonderahe, and Palmisano, 1956). For electrical studies, four pairs of stainless steel needles were inserted under the skin so as to span four regions of the body (fig. 2), namely, the head, chest and heart, the lumbar, and the pelvic regions of the trunk. A Grass Model III-D 4-channel electroencephalograph was used for recordings. The electrical activity is interpreted as being of muscular origin with modifications by the nervous system

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and superimposition of an electrocardiogram, especially in recordings from the chest. Metrazol (pentylenetetrazol) at a dosage of 1 mg per gm of body weight was injected into the abdominal cavity during the 30 minutes of exposure to extreme temperatures. In the salamander at moderate temperature this dosage of Metrazol induces a violent seizure, as manifested by external behavior and electrical activity (Peters and Vonderahe, 1954). During the transitional periods the temperature within the abdominal cavity typically lags behind that of the external environment by about 2° C. At the end of 30 minutes exposure to extreme cold the internal temperature reaches 0° C. However, at the end of 30 minutes exposure to 44° C the temperature within the abdominal cavity is at 40° C. Unless stated otherwise, the observations and illustrations (figs. 1 and 2) refer to temperatures of the external environment. Separate animals were used for behavioral tests, electrical recordings, reaction to Metrazol, measurement of

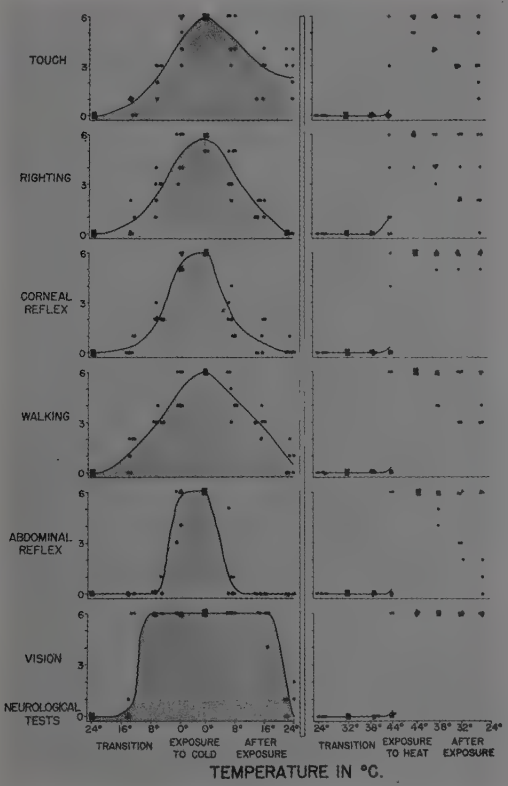

FIGURE 1. Graph illustrates the modification of neurological responses of salamanders subjected to extremes of temperature indicated on the lowest line of the horizontal axis. On the vertical axis, 0 signifies a normal response to various neurological tests, 1 to 6 degrees of depression, with 6 indicating complete extinction of response. Each dot represents the result of a test on a single salamander. Under the influence of cold, the responses gradually disappear, but return to normality with moderate temperature. Under the influence of heat, all responses are lost suddenly and simultaneously; some are regained temporarily before the death of the organism.

internal temperature with a hypodermic probe, and exposure to extremes of heat or of cold.

RESULTS

Although a more detailed verbal report of observations is given below, the reader may find it helpful to refer immediately to figures 1 and 2 in which the neurological changes are graphically summarized. In figure 1 temperature changes are indicated on the horizontal axis; different behavioral tests and various degrees of depression accompanying the changes in temperature are indicated along the vertical axis. Zero indicates a normal response, and the numbers 1 to 6 refer to degrees of depression, in which 6 refers to complete extinction of response. Twelve animals were used to compile figure 1, and each dot represents the result of a single test on a single animal. Modifications of electrical activity of neuromuscular system and heart which accompany changes in temperature are illustrated in figure 2.

Neurological Changes during a Lowering of Temperature

As the temperature drops from 24 to 0° C, the salamander exhibits a sequential loss of neurological responses. The first influence of cold is evident at 14° C when walking, righting, and the responses to touch are performed more slowly. As the temperature drops to 7° C, walking and righting become more labored; the corneal reflex is less prompt; the response to touch is negative unless a strong stimulus is applied; and attempts to evoke optokinetic nystagmus are unsuccessful. When 0° C is reached, the abdominal and corneal reflexes disappear, and touching is followed by an occasional weak response. When placed on its back, the salamander makes a few feeble attempts to right itself by movements of trunk and limbs, Eventually the forelimbs lose the ability to support the body, and finally the effort to walk degenerates into an erratic placement of limbs without any forward movement of the animal. If the salamander is transferred to water of the same temperature (0° C), it neither swims nor rights itself. At the end of 30 min at 0° C the salamander is limp and shows no response to the various stimuli employed in this study. In some superficial blood vessels, with the aid of a microscope, blood cells can be seen to be moving rapidly while in other vessels they appear motionless. Recordings of electrical activity at 0° C indicate that a lowering of temperature is accompanied by a decrease in the amplitude and frequency of waves from the neuromuscular system. The frequency of the heart beat has diminished from about 45 beats per minute at 24° C to 5 beats per minute, and at lowered temperature each heart cycle consumes a longer time. At 0° C neither behavior nor the electrical record showed changes following an injection of Metrazol.

As the temperature is raised gradually from 0 towards 24° C, the salamander regains responsiveness to various stimuli in the following sequence (fig. 1). At 7° C the abdominal and corneal reflexes are sluggish but definitely present. The animal recovers the ability to right itself and to walk slowly. The response to touch is small and inconsistent. The test for optokinetic nystagmus remains entirely negative. The electrical record shows a slight increase in amplitude and some acceleration of the heart rate. As the temperature approaches 12° C salamanders previously receiving an injection of Metrazol of 0° C begin to show gasping, some spastic movements and opisthotonus. With a further rise in temperature clonic behavior becomes more conspicuous.

At 14° C the corneal and abdominal reflexes are prompt; spontaneous movements of trunk and limbs occur more frequently; and walking and righting are less labored. However, the response to touch remains only slight and the visual test is negative. The electrical record shows a further increase in amplitude.

When a temperature of 24° C is reached, the salamander shows positive re-

sponses to all the neurological tests, but there is still some lack of promptness especially in the response to touch. The electrical activity of neuromuscular system and the heart rate return to the amplitude and frequencies recorded at the outset of the experiment dealing with cold. Within 24 hours at a temperature of 24° C the salamander appears normal in all respects, and observations over the next few days reveal no abnormalities due to the exposure to 0° C.

Neurological Changes with a Raising of Temperature

The neurological changes which accompany a rise in temperature are graphically summarized in figures 1 and 2. The sudden depression of all responses at 44° C, and the individual differences between salamanders during the transition from 44° to 24° C did not permit the plotting of a curve for these observations. This fact is a noteworthy difference between the effects of extreme heat and cold on the behavior of the salamander. Modifications of electrical activity of the neuromuscular system and the heart during extreme heat are illustrated in figure 2.

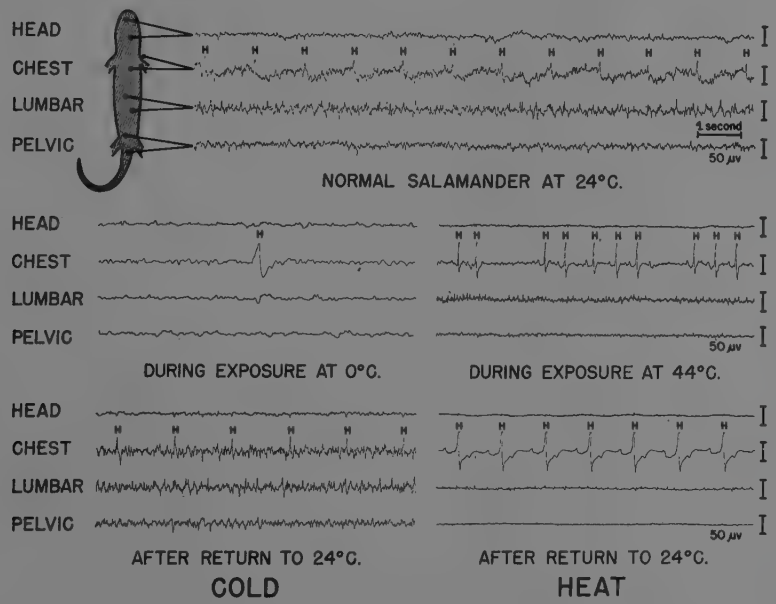

FIGURE 2. Electrical activity recorded from specified regions of salamanders at the temperatures indicated beneath each record. During exposure to either extreme of temperature the electrical activity of the neuromuscular system diminishes in amplitude. Cold slows the heart rate; heat induces acceleration and irregularity. After a return of 24° C., salamanders exposed to cold regain a normal electrical record while those exposed to heat show continued low amplitude and a modified electrocardiogram (H).

As the temperature rises from 24 to 34° C the salamanders manifest no conspicuous abnormalities, except increased rapidity in attempts to escape. Above 34° C these escaping reactions appear somewhat spasmodic. At 41° C activity diminishes, but the salamander gives prompt responses to the various stimuli employed in the neurological tests (fig. 1). When the animal is motionless, the electrical records from the head and trunk show waves of moderate amplitude with

a frequency of about 30 to 40 per second; the amplitude can be temporarily increased by touching the animal. At 44° C the heart rate may reach a frequency of 120 beats per minute. At some time during the exposure to 44° C, the exact moment is not consistent, the salamanders typically exhibit a cloniclike lashing of the vertebral column, lasting about 30 seconds, followed by slow serpentine movements of the trunk, lasting several minutes. When this episode of violent activity ceases, the salamander enters a stage of inactivity and offers no response to any of the stimuli employed in this study. At this time the electrical record shows a decrease in the amplitude of the electrical activity of the neuromuscular system (fig. 2); the heart rate is accelerated but irregular. Blood cells can be seen circulating in peripheral blood vessels. If Metrazol is injected into the abdominal cavity after the clonic-writhing episode described above, this stimulant does not evoke a change, either in the electrical record or in the behavior of the salamander. For about 50 percent of the salamanders exposed to high temperatures the events just described above culminate in a permanent disappearance of all vital signs; for them the electrical record persists at the noise level of the apparatus. For the remaining 50 percent the gradual lowering of temperature is associated with a temporary and depressed return of some of the responses to the stimuli used in the neurological tests. When a salamander regains these responses, they typically return in the following order: the response to tactile stimulation returns first, then righting, followed by walking. The abdominal reflex appears next and finally the corneal reflex. None of the salamanders showed a return of optokinetic nystagmus. The return of responsiveness is accompanied by some increase in the amplitude of the electrical record and an occasional resumption of a regular heart beat (fig. 2). Whatever responses are present at 24° C lack the promptness found in normal salamanders. The regaining of activity described above is of brief duration, for the animals become sluggish and die within 24 hours after the exposure to 44° C. Death is associated with a swelling of the body, vascular dilation, and some hemorrage in the oral and nasal cavities.

DISCUSSION

During the transition to and from cold temperatures, the successive loss and return of various responses may find an explanation in different resistances of various nerve fibers to certain degrees of cold, as suggested by Brooks (1956). The exposure for 30 minutes to either 44 or 0° C leaves the salamander immobile and irresponsive to stimulation. However, the results of the neurological tests immediately before and after exposure to these extreme temperatures indicate that the reasons for this condition are quite different in the two experiments. The lower range of temperature produces a motionless animal presumably because it raises the threshold of receptors and effectors, delays conduction of nerves (Tasaki and Fujita, 1948) and contraction of muscles, and diminishes the ionic activity (Crescittelli, 1957) associated with the electrical discharges by the neuromuscular system. The lowered frequency of heart rate and the protracted time for individual beats suggest that lowered temperatures decrease the irritability of the pacemaker and slow conduction in the auriculoventricular bundle. The deep depression associated with cold is temporary as proved by the return to normal behavior and normal electrical activity when the organism is returned to an environment of 24° C. Apparently the salamanders suffered no permanent injury when exposed to 0° C for 30 minutes.

The simultaneous disappearance of all responsivness to tests (fig. 1) and the drop in amplitude of the electrical record of the neuromuscular systems in some salamanders after an exposure to 44° C suggest that heat has a tendency to cause sudden and widespread changes in the organism. In all the salmanders the injury caused by heat was permanent and lethal, even though individual differences were manifested in the resistance to heat and in the temporary return of some of the responses.

The cloniclike lashing and subsequent writhing induced in the salamander by exposure to extreme heat permits several conclusions. This behavior may be regarded as a convulsant type of activity induced by heat similar to the convulsions induced by heat in mice (Swinyard and Toman, 1948). Clonus, a tonic phase, and writhing are conspicuous phenomena in convulsions induced in salamanders by both electrical and chemical agents (Peters and Vonderahe, 1953, 1954). Since clonic activity may be associated with the striatum or diencephalon (Peters, Vonderahe, and Hehman, 1959) it is probable that these centers of the brain have a lower threshold to stimulation by heat than the spinal cord which is responsible for writhing.

It is noteworthy that the heart continues to beat and show electrical activity for some time after the neuromuscular system has lapsed into electrical silence. This persistance of the electrocardiogram may find an explanation in the greater resistance of heart tissue to heat or to its protected location deep within the organism.

The results of this investigation offer further evidence for the view that not merely the range of temperature and the rate of change but the duration of exposure is an important factor in the modification of behavior of the survival of an organism, especially at higher temperatures (Orr, 1955). At the onset of the exposure to 44° C the neurological tests and the electrical records from the neuromuscular system showed no conspicuous abnormalities; longer exposure finally resulted in drastic and lethal changes within the organism.

SUMMARY

1. The salamander, *Triturus viridescens*, was subjected to a series of nuerological tests during exposure to extreme cold, 0° C, or heat, 44° C. These tests involved walking, righting, corneal and abdominal reflexes, optokinetic nystagmus, response to touch, recordings of electrical activity of the neuromuscular system and the heart, and the reaction to the nervous stimulant, Metrazol.

2. Exposure for 30 minutes to either extreme cold or heat results in the loss of responses to external stimuli, eventual reduction in amplitude of the electrical record from the neuromuscular system, and no activation after an injection of Metrazol. The heart rate is decreased by exposure to cold, accelerated and made irrgular by exposure to heat.

3. During the exposure to cold all responses become slower; as temperature falls, optokinetic nystagmus disappears first, corneal and abdominal reflexes last; as temperature rises they return in reverse order. All animals recover completely.

4. During the exposure to heat, after a seizurelike episode, all responses are lost suddenly and simultaneously. As temperature returns towards 24° C some responses are regained temporarily. All salamanders exposed to heat die within a few days.

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Landscapes of Alaska. *Howel Williams, Editor.* University of California Press. xii+148 pp. $5.00.

The U. S. National Park Service joined with the U. S. Geological Survey to present the geological history of Alaskan landscapes, and the Press of University of California "did themselves proud" in publishing their report. Illustrations are superb, starting with a frontispiece in color of Mount McKinley, including a series of aerial photographs in black and white, and six maps (some in color) of the physiographic provinces of the new State. Chapters deal with these provinces one by one, each chapter written by an authority.

Three figures are of outstanding interest. One shows the evolution of OKmoh caldera on Umnak Island, another presents a glacial and permafrost map of Alaska, and the third includes four sketches which show the development of the Bering Sea Land Bridge.

An appendix includes a Geologic Time Scale and a glossary, and there is an excellent index. The study was well conceived and the report was well prepared. It makes good, interesting reading.

THOMAS H. LANGLOIS

The Gulf Stream. *Henry Stommel.* University of California Press. xiii+202 pp. $6.00.

The purpose of this book is stated to be "to describe and explain what is known about the Gulf Stream in a way which will interest physical scientists, for but few scientists have any knowledge of the nature of this grand natural phenomenon." The author tries by means of this book to communicate the facts and theories concerning the Gulf Stream to a wide scientific audience.

The book presents records of early ideas and explorations and brings the history to date, then discusses methods of observation and instruments used. The amount of the Gulf Stream begins with a statement of the balance of forces at work with discussion of schematic density and pressure fields. Then follows a description of the large-scale features of the North Atlantic circulation and the hydrography of the Gulf Stream. A technical discussion of the wind system over the North Atlantic leads to the Linear and non-linear theories of the Gulf Stream, meanders in the stream, fluctuations in the currents, and the role of thermohaline circulation.

The concluding remarks present significant facts for the layman, such as the following:

"The Gulf Stream flows along the western boundary of the warm Sargasso Sea surface water. As the stream turns toward the east, off the Grand Banks, it acts as a kind of dynamic barrier, or dam, which, by virtue of Coriolis forces, restrains the warm Sargasso water from overflowing the colder northern water of the North Atlantic. The water in the stream is not significantly different in temperature from the large mass of warm water which lies to the right of its direction of motion. The Gulf Stream is not an ocean river of hot water. The intensity of flow of the Stream, the Stream's direction, and its temperature are not primary climatic factors in determining the climate of Europe; but the role which it plays in determining the northern boundaries and average temperature structure of the Sargasso Sea must be of critical climatic importance. . . . It is really a flow along the very edge of the juncture of a mass of cold water and a mass of warm water. . . . It is a boundary phenomenon . . . as a recognizable part of a larger physical system. . . . Therefore, one is led to inquire whether the primary physical phenomena to discuss are not the origin and nature of the two contrasting water masses, and whether it is not proper to regard the Gulf Stream current system as merely a secondary feature associated with their zone of contact."

THOMAS H. LANGLOIS

PRACTICAL REASONS FOR ALGONKIAN INDIAN STREAM AND PLACE NAMES

AUGUST C. MAHR[1]

Department of German, Ohio State University, Columbus 10

INTRODUCTION

There is a good reason why, in the North-American East, Middle East, and, partly, in Kentucky and West Virginia, the frequently occurring Indian names for streams, places, and neighborhoods are of Algonkian rather than Iroquoian provenience. Although in their cultural character more southerly than the Alkonkians, who mainly lived south of them, the Iroquoians, principally the Five (or Six) Nations, had since their first contacts with the colonializing Europeans remained sedentary in their old settlement area in the northern parts of the present State of New York. The Algonkian Delaware, however, although hailing from the north, roamed southward first, to eastern Pennsylvania afterwards, and finally, under white pressure, westward through the full length of Pennsylvania and into the Ohio Country along the Muskingum, their Wolf Tribe, the Munsee, staying in the regions of northwest Pennsylvania. In the Muskingum basin, the Delaware (or Lenni Lenape) were preceeded by their Algonkian cousins, the Shawnee. First met by Whites in the south, in the 17th century, the Shawnee lived in two separate portions, on the Cumberland river in Tennessee and Kentucky, and on the Savannah river in South Carolina. Toward 1700 the eastern section migrated into northeastern Pennsylvania, and early in the 1700's the other moved eastward and, eventually, across the Ohio river. When the eastern column, about the middle of the 18th century, migrated from northeastern Pennsylvania westward to the Ohio river system, the two formerly separate portions of the Shawnee met about 1750 in the Ohio country and united for the first time in their nation's history (Encycl. Brit., 1941, 20).

After 1770, when the Moravian Indian Missionaries, Zeisberger, Heckewelder, a. o., had begun to write down their observations about the Indians in the Ohio Country, they found the majority of the Shawnee safely entrenched along the Scioto and in the parts northwest of it while only a few settlements of the former eastern Shawnee still existed on the Muskingum, near present Dresden, Ohio. After Col. Lewis, one of the lieutenants of Lord Dunmore, had, in 1774, defeated the united Shawnee forces in the battle of Point Pleasant, at the Kanawha just south of the Ohio river, Lewis' army did away with the last vestiges of Shawnee influence in Eastern Ohio. Although no real territorial jealousy had existed between those Shawnee and the Delaware who, since about 1760, had likewise come up the Muskingum and had peacefully settled in the neighborhood, the hunting and corn-planting grounds of that region, henceforth, were uniformly Delaware.

Not the strictly bounded territory but rather the use of what today is Ohio roughly was the Delaware region of the 1770's. The ridges following the Hocking valley in the southwest formed the line across which the rights of the Shawnee began. It was respected on both sides. West of the Shawnee there lived the likewise Algonkian Miami (or Maumee) Indians. North of the Shawnee, around the west shore of Lake Erie, as far to the east as the Sandusky river and its mouth, was the Wyandot region. Although politically unassociated with the Six Iroquois Nations, the Wyandot were Iroquois but closely affiliated with the Algonkian Shawnee. Without the aid of interpreters, they could not understand each

[1]Professor Mahr has been emerited since 1956. *Mailing address:* 2079 West 5th Avenue, Columbus 12, Ohio.

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others' language; nor was there an understanding possible between the Wyandot and the Delaware. For that matter, not even a Delaware and a Shawnee, although both of them Algonkians, could (or still can) converse outright; not any more so than can a German and Holland Dutchman, both of whose languages are West-Germanic.

All of that had to be said, or the following would make little sense. In writing, there exist no Indian sources of Indian migrations. All that is known about the names of North American Indian tribes and their movements stems from the writings of white men, mostly missioners from various churches. The earlier ones, in the 17th and 18th centuries, came mostly from the Jesuit missions in the Middle West. Later, in the second half of the 18th century and in the early 19th century, the authors on Indian life were mainly missionaries in the Indian Mission of the Moravian Church at Bethlehem, Pennsylvania. Eventually, in steps, they led their Delaware and Mohican Indian converts from the Wyalusing mission stations into the Tuscarawas valley in the Ohio Country, the new mission towns of Schönbrunn (Delaware, 1772) and Gnadenhütten (Mohican, 1773). Here, Zeisberger, Heckewelder, and their associates did most of their valuable writing on the life, history, and language of the Algonkian Delaware among whom they labored. It is one of the essential features of those Moravian Mission migrations that, in spite of the Moravian leadership, they operated strictly on the age-old principles of aboriginal Algonkian tribe traveling (Mahr, 1952; 1953).

CANOE TRAVELING

Whether moving in small bands, or in big ones of two hundred or more, an Indian migration always tried to take its start by canoe on a big water course, let's say, the Susquehanna or the Ohio. That main river was followed until, for some reason, it seemed more expedient to paddle up one of the tributaries and the one or other creek emptying into it. The surroundings were probed for hunting, fishing, corn-planting, and for other necessities important in Indian life.

True, that was significant at all times, but it became of paramount importance when, by means of migration, an entirely new, often totally unknown, living area, sometimes far away from home, was to be opened up. For that reason, travelers in canoes and such already settled marked river mouths and other inlets to the inland with characteristic names, in order to hint to other canoe travelers of the tribe, following after, what at a given point lay ahead of them. That is why some of the Delaware river names of Ohio apply to the mouth of the river rather than to the river in its full length. The Licking river, for instance, a tributary to the Muskingum, is one of those. The name, *Licking*, is adapted from the original Delaware form **W'lí/'ik'/'nk*. It means: 'where there is (*-'nk*, locative affix), at a given point (*w'lí-* 'yonder'; Zeisberger, 1887), receding flood water' (*'ik'-*). Note that the verb stem *'ik* basically implies 'a *dropping* water level' (Brinton, 1889). To Delaware Indians canoeing up the Muskingum, the name indicated that, at times when the Muskingum carried high water, the flood backed up in the mouth of the Licking as far as a certain point upstream and, therefore, promised good canoeing; but afterwards it receded again, and so one had to look out. As early as 1764, the Licking appears on an ancient map (Bouquet, 1764). Another name, *Pataskala*, was given the Licking by other Delaware Indians for the same purpose of canoe navigation and remained in use until far into the 19th century (Jenkins, 1841). *Pataskala* is a white man's transcription of Del. **P'l 'as ku' 'l'w*, meaning: 'up to some point (*p'l-*), always (*as-*, *-aaps-*; Unami dialect for Del. Munsee *aptchi* 'always'), a swell of the water (*-'ku'-*, properly *-l'kui-*, 'a wave from a tide or flood'), (it) exists (*-'l'w*, 'it exists [in motion]'". For a more detailed analysis I refer to a former article (Mahr, 1957, p. 148–149). What alone is essential, though, is the identical meaning of the names *Licking* and *Pataskala*, in their original Delaware forms, for the same river, or rather its mouth.

When, somewhat before the Delaware, migrating Shawnee bands had come up the Muskingum, they had eventually arrived at that river and examined the possibilities for settling there. Their name for the Licking river was **Nepipenime* (Johnston, 1820: *Nepepenime*). Its composition is: Shawn. *nepi–* 'water,' *–pen–* 'below,' and *–ime* 'it is' (Voegelin, 1938-40, pp. 95, 338, 375); it means 'there is water below,' indicating that 'here is a river with water at its lower course'; that is, 'a river navigable only near its mouth.' Thus, at different times, traveling tribesmen from two separate Algonkian nations made identical observations about the same river and embodied them in the same name, for the same purpose, in their respective languages.

There is also a river in northwestern Pennsylvania, likewise called *Licking* by the Delaware, most likely even before they arrived in the Muskingum valley. *Licking Creek* obviously was given its Delaware name under the same geographical conditions as was the Licking river in Ohio. The stream is shown under the name 'Licking' on a map of 1765. (Wm. S[cull?], 1765). The same map makes it clear how carelessly Indian names always have been handled. A big river, which is doubtless supposed to be the Licking river of Kentucky, entering the Ohio near present Cincinnati from the south, on that map bears the name 'Great Salt Lick R.' Early settlers seem to have given it that name, because there were salt licks at or near it. Only later, there appears the present name, Licking river, its Delaware Indian name; not however, given it by Delaware Indians (who never migrated that far west on the Ohio) but again by white people as it seems. Eventually, a fanciful folk-etymology of English-speaking whites had connected the Delaware name *W'lí/'ik'/'nk*, and its white pronunciation Licking, with the English 'lick' or 'salt lick.' A county historian (Hill, 1881) even goes so far as to explain the river name, Licking, "from the fact of there being in early times some 'salt licks,' as they were called, upon or near the banks, which were much resorted to by deer and buffalo." So, why not also have that big Kentucky river called 'Licking' instead of that clumsy 'Great Salt Lick River'?

Under certain circumstances which cannot be discussed here at greater detail, Delaware canoe travelers did not advance inland from the Ohio river alone, but some also came from the north, the shores of Lake Erie. From the lake, they paddled up the present Huron river which they called *Pettquotting* (as the name is spelled in Moravian Mission diaries). It will be shortly seen that, as seasoned canoe travelers, they again had named the lower part of the river rather than the river in its full length. *Pettquotting*, in Delaware, is **P't/t'ku'/'att'/'nk*. It is compounded, as follows: *p't–* 'up to (a certain point)'; *–t'ku'–* 'a wave (from a tide or flood),' *cf.*, above, p. 366; *'att'–* (*-hatte–*), verb-stem 'doing, making, being'; and locative affix *–'nk* 'where there is.' Composite meaning: '(river) where there is tide-water up to a certain point.' In other words, 'up to a certain point, that river is always on the same level with the lake.'

Migrating, even to distant parts, cannot change the basic life habits of people who, by canoe and trail, are always moving anyway. Nor, of course, could it in the least affect the Delaware Indians' age-old practical tendency to provide telling names for watercourses and landmarks, revealing to travelers on river or trail what was to be expected ahead. In the east and the west, the same people used the same Delaware language, and the traveling conditions they encountered were not too different either. So, when they met a stream, formed by the running together of two streams, it was given the name *Nish/hán'k* (or *Nish/hánna*, *Nish/hánne*), literally 'two-stream,' be it in the eastern Delaware domain in New Jersey, or in the western one in Mercer Co., NW Pennsylvania. It has been listed for Mercer Co. as *Nîschhannôk* by Heckewelder (1843: 365) who interpreted it as "two adjoining streams," and it has survived in both states as *Neshannock*. Del. *nishi* is 'two' (Zeisberger, 1887: 207).

When a stream was encountered, with an important river fork in its course,

it was likely to be named accordingly, for the benefit of canoe travelers. For old Mercer Co., Pennsylvania, Heckewelder listed the present Lackawannock as *Lackawanak*, giving its Delaware name as *Lechauhannek* which he interpreted as "the forks of two streams" (Heckewelder, 1834: 365). For the Lackawanna in NE Pennsylvania, he gave *Lackawannok*, with the Delaware name "*Lechawahhannek* . . . also *Lechauhanne*," in English "forks of the river" or, inexplicably, "forks of *a* river" (*ibid*,: 361). Of course, both the western and northeastern forms are versions of the same name and were correctly handled by Heckewelder. Its basic Delaware form is **L'chaw'/hán'k* (or **L'chaw'/hánne*) (Zeisberger, 1887: 78).

HUNTING

Whether on the march or at home, the Delaware Indians, men, women, and children, mainly subsisted on meat. Plentiful hunting, therefore, was not a luxury but a constant necessity. Hence, it was an advantage to the tribe to be familiar with names for localities where the hunters were most likely to find enough game animals to supply the common need. Thus, it happened that in the entire Delaware terrain, from the Atlantic into Ohio, there exist, less in the original Indian than in English adaptations, innumerable rivers, creeks, runs, etc., named after bear, beaver, deer, fawn, elk, and other game animals: *'hunters' hints,'* if there ever were any. Very much the same is true for the former hunting grounds of other Indians, especially Algonkians such as the Shawnee, Miami, Ottawa, Chippewa, Menominee, etc., both in the United States and Canada.

It appears that in Pennsylvania, that is, in the eastern portion of the Delaware Indian domain, such *'hunters' hints'* have better persisted in their original Delaware versions or, at least, semblances of such, than west of Pennsylvania. On modern maps, for example, there occurs *Moshannon* as the name of a southern tributary to the Susquehanna's West Branch, in Clearfield Co., Pennsylvania; an older version, *Moshannock*, is mentioned by the Moravian missionary Rev. John Ettwein, who in 1772, when leading a migration of Delaware and Mohican mission converts westward, made camp at that river (Jordan, 1901: 213; Mahr, 1953: 263). *Moshannock* exactly reflects Del. *moos/hán'k*, a compound from *moos* 'an elk,' and *-han'k* (*hana*, *-hane*) 'a stream (in compounds),' meaning 'Elk Creek.' Farther toward the SE, in Berks Co., on U. S. Rd. 222 between Reading and Allentown, we find a place name, *Maxatawny*, and not far from it, on Pa. St. Rd. 100, *Macungie*. Roughly fifty miles NW of it, in Schuylkill Co., on the Tamaqua river, there occurs another place name, *Tamaqua*. All three names indicate that, formerly, they had been Delaware *'hunters' hints.'*

As the original Delaware name form for *Maxatawny*, the Moravian missioner Rev. John Heckewelder established *Machksithanne* and correctly interpreted it as "bears' path creek *or* the stream on which the bears have a path" (Heckewelder, 1834: 360). It is a compound of *machk-* 'a bear,' *siit-* 'foot (in compounds),' and *-hane* (*-han'k*, *-hana*) 'stream, creek, river (in compounds)'; *comp.*, Zeisberger (1887).

Another such hint at good bear-hunting was *Macungie*. Heckewelder gave its Delaware form as *Machkunshi* (spelling modified), which he rendered as "the harboring *or* feeding place of bears" (Heckewelder, 1834: 357). It combines *machk* 'a bear' and *kawunsh* 'thorn bush, hawthorn' (Zeisberger, 1887: 197), and is affixed with the emphatic final *-i* (*-e*) 'indeed.'

Heckewelder likewise listed the true Delaware name form for present *Tamaque* (Heckewelder, 1834: 361). He wrote *Tamaquon* and stated that its correct Delaware version was *Tamaquehänne* "or (short) *Tamâkhanne*, the Indian name, as it stands on record, for Little Schuylkill." His interpretation is "beaver stream." The Delaware term is a compound of *l'machkw'* (also *amôchk*, Zeisberger 1887: 20) 'a beaver,' and *hane* (*han'k*, *hana*) 'stream, creek, river (in compounds)'; *comp.*, Zeisberger, (1887: 160).

A great many *'hunters'-hints'* names, however, made no such special mention of the game which they promised. Their hints were broader. It was well known, for instance, among the Delaware and other Indians that there was good hunting of all sorts of game near any natural outcropping of salt, be it a salt lick or a saline spring which equally attracted the animals. That is why in the whole Delaware territory the Indian hunters formed numerous names for big and small water courses with their term *m'honi* 'a salt lick,' usually adding to it their locative final *–'nk: m'hónink* 'where there is a salt lick.' Because of salt licks in their head waters, several such streams were called *m'hónink sitpunk*, or *m'honink/hánna*, 'river where there is a salt lick.' These were outstanding *'hunters' hints.*' Whoever could went there hunting. Even on modern maps, the river name *Mahoning* occurs. One such *Mahoning* is found in NE Ohio (and W Pennsylvania), and another as an eastern tributary to the Allegheny river in Armstrong Co., Pennsylvania. Early in the 1800's, the Big Lick Creek near Columbus, O., today called Big Walnut Creek, bore the Delaware name *M'nkwi M'hóni Sitpunk*, such as transliterated from a reliable source (Lee, 1892: I, 145) and an exact equivalent of 'Big Lick Creek' (Mahr, 1957: 143). Needless to say, the English adaptations of such Delaware *'hunters' hints'* are legion where Delaware Indians ever had their being.

'Saline springs,' or 'salt wells,' were not by far so frequent as were the 'salt licks,' but their attraction for the game animals and their Indian hunters from far and near was all the greater. A 'saline spring' became a hunting center, and its Indian name, a powerful *'hunters' hint'* all throughout the region, long before its eventual development into a salt industry near the end of the 18th century. That is true, in particular, of two 'salt wells' in the old Ohio country: one, at the head waters of Salt Creek, an eastern tributary of the Muskingum, in present Muskingum Co., Ohio; the other, farther west, near the lower Scioto, in the center of present Jackson Co., Ohio (Jenkins, 1841).

Among the Delaware Indians all around, the current name for the 'saline spring' in the Muskingum region was *Sikhéwink*, meaning 'where there is salt-making.' On that canoe journey with his convert Indians from the Big Beaver to the Tuscarawas missions, Heckewelder visited it in 1773 (Mahr, 1952: 295). The Delaware term, **siik/hée/wi/nk*, is a compound from *siik–* 'brine'; *–hee–*, a verb stem meaning 'making'; *–wi–*, an adjectival copula which cannot be translated; and *–nk*, a locative final, 'where there is.' As the component *–hee–* clearly confirms, *Sikhéwink* no longer was the Indians' regional hunting center only, but here they came from all around to boil salt out of brine, under white influence, of course.

No such indication exists in the name of the 'salt well' near the Scioto, which in Delaware is **Séek/'l'w* (transcribed from "Seckle," Lee, 1892: 145), a compound of *seek–* (*siik–*) 'brine' (as in *Sikhéwink*), and *–'l'w* 'it exists (in motion)'; meaning: 'brine wells up.' *Séek'l'w Sitpunk* was the Delaware name for *Salt Creek* which empties into the lower Scioto, with that 'salt well' and Indian hunting center in its head waters (Lee, 1892: 145).

Both to tribespeople migrating overland and to hunters on the trail, certain Delaware names did not serve as hints but rather as warnings; as warnings, not to make camp at a location. One such place, still marked on modern maps of Jefferson Co., Pennsylvania, on the upper course of the Mahoning, was *Punxsutawney*. It always had been a marshy region, and the Delaware, traveling through, had given it the name *Punk's/utènai*, because of the countless gnats that infested it (Del. *pünk's*, or *pünkwes*, ' a stinging gnat,' really 'dust creature'; and *–utènai* 'a town, gathering place'; *cf.* Zeisberger, 1887; Heckewelder, 1834: 364).

Heckewelder's travel notes of 1773 contain a similar warning against a camp site near present Brokaw, on the Muskingum, in Morgan Co., Ohio. The migrating Delaware designated it as *Tskwal/utènai*, 'gathering place of frogs,' for the

infernal noise of the frogs in the nearby marshes would not let the campers sleep that night. (Mahr, 1952: 294; Heckewelder spells *Tsqualluténe*). The name's composition is Del. *tskwal-* 'a frog, toad' (Zeisberger, 1887) and *-utènai* 'a town, gathering place.'

FISHING

To the Delaware Indians, as true Algonkians being mostly on the move whether by canoe or by trail, hunting and fishing went close together. Even long after they had by necessity become more sedentary, meat and fish had remained the staple foods of the Delaware and other Algonkian Indians. That is clearly reflected in a few Delaware stream and place names from Pennsylvania, the eastern and culturally older Delaware domain. The accepted form of the much debated Delaware name for the ancient settlement of *Shamokin* in Northumberland Co., Pennsylvania, is **Shachamokink* (Heckewelder, 1834: 363; Mahr, 1953: 259), its meaning being 'place where there are eels'; Del. *shâachameek* is 'an eel' (Zeisberger, 1887: 64).

Moselem Creek, near Kutztown in Berks Co., Pennsylvania, was named *Mashilameek/hanne* (Heckewelder, 1834: 360), 'trout creek'; a compound from **m*ˈ*shíla/meek* 'a trout' (Zeisberger, 1887: 205; transliterated); and *-hanne* (*-han*ˈ*k*, *-hanna*) 'a stream, creek, river (in compounds).'

Temporarily ranking 'turtles' with fish food, we see another such '*fishermen's hint*' in the Delaware name of *Tulpehocken*, in NW Berks Co., Pennsylvania. Its original form was *Tuulpe/wi/hákki/*ˈ*nk*, meaning "the land abounding with turtles" or "the turtle country" (Heckewelder, 1834: 360). It is a combination of *tuulpe-* 'a turtle' with *-wi-*, an adjectival copula; *-hakki-* 'land, soil'; and locative final *-*ˈ*nk* (*cf.*, Zeisberger, 1887).

A '*fishermen's hint*' at a much wider scale may be seen in the name *Ashtabula* near Lake Erie, in the western section of the Delaware domain, not far from the Pennsylvania boundary. Originally, the Indian name must have exclusively applied to the Ashtabula river since its Delaware form, **Ash*ˈ*/*ˈ*pé/*ˈ*w*, means 'there is always enough of it moving,' doubtless with reference to fish in the water. The term combines Del. *ash*ˈ (*aptchi-*) 'always' with *-*ˈ*pe-* 'enough,' followed by the verb-form *-*ˈ*w* 'it exists (moving)' (Zeisberger, 1887). It was a clear hint at plenty of fish that could always be taken there.

West of the Delaware Indian domain, and even west of the Scioto river system settled by the Shawnee in the second half of the eighteenth century, there occurs another such 'fishermens' hint' in Kosciusko Co. of the present state of Indiana: *Tippecanoe*. Originally, the Algonkian Miami Indians gave the name *Tippecanoë* to a lake and to the stream which springs from it, a northern tributary tot he Wabash river. *Tippecanoë* remarkably well preserves its basic Miami speech form, which was **Täpi/kinóji*, meaning 'plenty of pike.' It was a compound from Miami *täpi-* 'enoughness, plenty of' (Shawn. *teepi*-) (Voegelin, 1938-40: 135 f.), and Miami *-kinoji* 'a pike' (Shawn. *kinw-*, *kin-* 'long') (Voegelin, 1938-40: 305).

Strangely enough, we possess in its original version not a single Shawnee name for a stream or locality coined for the express purpose of directing the hunter or fisherman. That might indicate that those Shawnee of the later 1700's had, in the course of time, become more sedentary, that is, more concerned with planting maize as their staple food than their Algonkian cousins, the ever roaming Delaware.

CORN PLANTING

Shortly after 1750, a band of migrating Shawnee paddled up the Muskingum river, evidently in quest of a fertile area for planting corn to support a future settlement. If, as it is supposed, *Muskingum* is a Shawnee name adopted by the Delaware, who also called it Mus*h*kingum, the Shawnee seemed to have found

the flats of the river too swampy for corn planting. They named it **Mshkeekwaam* (Mahr, 1957: 145), a term combining Shawn. *mshkeekwi-* 'a lake, swamp' (Del. *m'skeek*; Zeisberger, 1887: 189. *Cf.* Voegelin, 1938–40: 363) with Shawn. *-aam-*, a stem denoting '(land, soil, etc.) being as indicated,' and inevitably followed by *-'chki* or some other locative determinant (Voegelin, 1938–40: 338), indispensable in Shawnee but dropped by Delaware Indians. Further, under the force of a folk-etymology, the Delaware connected *Muskingum* with Del. *moos-* 'an elk' and Del. *-w'shkiink* 'an eye' (transliterated from Zeisberger, 1887: 70). While the complete Shawnee name, **M'shkeekwaam'chkí*, unmistably indicates 'where the land is swampy,' that Delaware folk-etymology arrived at *Mooskinkum*, making the name of the river mean 'elk's eye.' Even Zeisberger fell for it (1910: 44).

Canoeing farther up the Muskingum, the migrant Shawnee, eager to settle down and to plant their corn fields, eventually found what they needed. It was a wide expanse of fertile bottom land within a sweeping curve of the Muskingum, near present Dresden, O. where the Wakatamika creek comes in from the west. For the benefit of their tribespeople coming the same way with the same intentions, the region was named **Waakitaamechkí*, meaning 'it is river-bend land.' The Shawnee term *waak'/it'/aam/echki* is a compound from *waaky-* 'crooked, bent outward' (Voegelin, 1938–40: 416); *-ite-*, vague locative, 'in that place' (*ibid.*: 151); and *-aam/echki* '(land, soil, etc.) being as indicated,' plus locative *-echki* (*-'chki*) (*ibid.*: 338). Here, as so frequently with the Shawnee, whether at home or migrating elsewhere, the name was given to an entire area rather than to a single place, in order to make known its potentialities for settlements, that is, for the feeding of the settlers by growing maize. For an equally practical purpose, the settlements themselves, if newly laid out, were differentiated according to the clan that at the time inhabitated them.

The same may be said of the Delaware who, a decade or two after the Shawnee, likewise penetrated the Ohio country by way of the Muskingum river. When it became necessary to decide upon a location for their nation's capital where their Grand Chief, Netawatwes, could convene his Delaware Grand Council, a convenient site was chosen near present Newcomerstown, somewhat above the Tuscarawas river, the north branch of the Muskingum, in today's Coshocton Co., Ohio. It was the principal settlement of the Unami, or Turtle, tribe from which the Delaware Grand Chief was chosen. Old 'King' Netawatwes himself, who had eventually led his Delaware here from eastern Pennsylvania, was to reside in that town where individuals and delegates from all three Delaware tribes and from other Indian nations were expected constantly for business with the Chief and his Council, and—most important of all—to be supplied with food. Hence, the site of the settlements was to be unmistakably identified by the many strangers who were to visit here; so it was given the name *Kekalamûkpechink*, in Moravian documents spelled *Gekelemûkpechunk*. The Delaware (Unami) form was **K'k/-alam'/oók/pech'/'nk*, a compound of *k'k-* 'winding around' (*cf.*, Shawn. *kky-* 'turn, circular object,' Voegelin, 1938–40: 298); *-alami-* 'inside' (see Zeisberger, 1887: 233); *-ook-* 'bend (of the river)' (Unami dialect for *-woak-*; *cf.*, Un. *-oon* for *-woakan*, an abstract word-final); *-pech'-*, a stem indicating nearness in space or time, 'near, soon' (Zeisberger, 1887: 128; Brinton, 1888: 110); and locative *-'nk* 'where there is.' The name signifies that 'the place is near (*-pech'/'nk*) a river bend (*-ook-*) winding around (*k'k-*) the bottom land at its inside (*-alam'-*).' It makes it clear that those who coined it were less concerned with the settlement than with the corn-growing facilities near it.

About twenty-five river-miles upstream from Newcomerstown, the Tuscarawas receives an eastern tributary, today called Stillwater Creek. Its Delaware name was *Kekalamûkpechink Creek*. Even the Moravian missionaries at nearby Schönbrunn and Gnadenhütten, otherwise well informed about Indian affairs, took it for granted that the Delaware had named *Kekalamûkpechink Creek* after their

national capital. Apparently, the utter nonsense of that did not occur to them. Europeans or white Americans, who always have been making their way of thinking the measure of all things, never thought twice about naming one place after another one. Not so the Indians. They had atrocities of their own, but 'Verona, O.' or 'Paris, Ill.' were none of them! Unless they had a good practical reason for it, they neither coined a new name for a stream or locality nor used one over again which had already been in existence.

Kekalamúkpechink Sitpunk of the Delaware is a good case at hand. Not even a white man would ever have thought of naming a stream after a town twenty-five river-miles south of it. How much less an Indian! A glance at a regional map shows that the Stillwater, coming from the eastern hills, reaches the Tuscarawas at a spot where the main river forms a loop around the rich bottoms within it, very much the same as it does near the capital site farther south of it. Hence, the same conditions prevailing, why should not also the same name, *Kekalamúkpechink*, be used for the mouth of the Stillwater and that stream itself? After all, the Stillwater and the Tuscarawas formed an important waterway for the many canoe-travelers to and from the capital, and the one name, *Kekalamúkpechink*, helped them to identify both places.

Not all the Delaware proceeded northward on the Muskingum. A migrating band of the Unalachtiko, or Turkey, tribe canoed down the Ohio for another twenty-five miles or so, as far as the mouth of the *Hocking* river, and paddled up all its navigable eighty miles. On old maps, that river is shown as *Hockhocking* (Bouquet, 1764) and *Hocking Hocking* (W. S[cull?], 1765), both of them white adaptations, the latter of which seems to reflect the original Delaware name **Hok'nk hákki·nk Sitpu·nk*, 'river where there is arable land above.' The term *Hok'nk·hákki·nk* combines adverbial *hok'nk–* 'high up; above' (Zeisberger, 1887: 2; 94); *–hakki-* 'land, soil' (*ibid.*: 110); and locative *-'nk* 'where there is' (Mahr, 1957: 150). Obviously, those Delaware who coined the name were, at that time, less preoccupied with hunting and fishing than with an expanse of land promising a plentiful corn crop. Their hopes were justified, or the river name, *Hocking*, even if crippled, would not have persisted until today.

OTHER NECESSITIES

It is safe to say that, next to food and drink, *face paint* took first place in American Indian life; less in the life of the women, however, than in the adult male's. As the American woman of today, white or colored, relies on advertisements for her cosmetics, so the red man used to expect the names of streams or localities to direct him to the sources of his *face paint*. For mysterious purposes, some of them symbolical, the Indian men daubed their faces and depilated parts of their heads with various paints. Not from vanity alone, but from social necessity. No more would a Delaware or Shawnee gentlemen have turned up among his peers unpainted, than a modern American would appear in public unshaved (*cf.*, Heckewelder, 1881: 202 f.). The pigments were made of various clays, which were mostly found in stream banks and, when fired, assumed the desired colors. If the clay was ferruginous, it yielded a brilliant red which was greatly preferred for the purpose. Thus, it became essential to learn the names of localities where those clays were likely to be obtained. Indeed, many names of that character occur throughout the former Indian domain of Pennsylvania and Ohio; a few, in the original Indian form, but more of them in English.

A Central Ohio river, called Big Darby on modern maps, was known to the Indians and early white settlers as the *Olentangy* river. The Delaware had named it **Olam' laámse Sitpu nk*, that is, 'face-paint now-and-then river'; from Del. **olám'-*, **olám'n* 'paint, *(red) face paint' (Zeisberger, 1887: 138, spelled: *allámman*), and *-laámse* 'now and then' (Brinton, 1889: 137; Zeisberger, 1887: 178).

Paint Creek, a western tributary to the Scioto, coming in near Chillicothe,

was called *Olomoni Siipunk* by the Delaware, that is, 'face-paint river' (Lee, 1892: I, 145; spelled: *Olomon Sepung*). The Shawnee named it, almost identically, *Holamoomii Thiipiichki* (Randall and Ryan, 1912: II, 26; spelled: *Alamoneetheepeece*). 'Face paint' in Shawnee is *holamo–*, *holamoom–* 'vermilion, face paint' (Voegelin, 1938–40: 454).

In 1760, on a journey along the Ohio shore of Lake Erie, George Croghan listed in his diary the Indian name of the Vermilion river as *Oulame Thepy* (Thwaites, 1904: I, 109). The Indian name clearly is an equivalent, in the Algonkian Ottawa language, to the Delaware and Shawnee names which those people gave to another stream farther south for the very same purpose of tagging the river as a source of face paint. Ott. **ulame* is a perfect parallel to Del. *olám'n* and Shawn. *holamoom*, all three meaning 'vermilion, face paint.' Correspondingly, 'Paint' streams of any size and location are innumerable wherever Indians lived.

Of very much the same importance to the North American Indians as the use of face paint was the *sweat-oven*. Its popularity was universal from the Atlantic to the Pacific. In principle, it was a natural or artificial cave in a slope of a hillside, with a pile of heated stones in it, and an animal hide curtaining its entrance. Water, with or without medicinal herbs in it, was poured on the red-hot stones, in order to create the steam for the bathers in the cave. Whenever an Indian had a cold, or was tired out for any reason, he resorted to the steam-bath. It also afforded excellent help for rheumatic complaints (Heckewelder, 1881: 225).

It seems strange that an all-Indian institution such as this did not cause more names for streams or localities than it did. The reason really is quite simple. Every Indian settlement, Delaware or ortherwise, naturally included at least two *sweat-baths*, one for the men and one for the women. Even Indians on the march temporarily put up a sweat-oven, if needed (Mahr, 1952: 294). A sweat-oven was a matter of course and no more discussed than breathing. This writer knows of only one exception which seems to prove the rule: *Pymatuning*. In the original Delaware it was **Piim/'attôon/'nk*, composed of *piim–* 'going to sweat' (Zeisberger, 1887: 189), *–hâttoon–* 'it is put there' (*ibid.*: 152), and locative final *–'nk* 'where there is.' The composite meaning is 'to go to sweat, it is put there'; or, in better English, 'here are facilities for sweating yourself.' Evidently, it once named a place on the Shenango river, in Mercer Co., Pennsylvania, where a much-traveled Delaware trail led by, which was used by Indians going north to, or coming back from, Lake Erie. Its name informed such travelers that *Piim-'attóon'nk* had a good sweat-oven which they could use. It is not to be discussed in these pages how it happened that, subsequently, the name, *Pymatuning*, was also carried (with white help) to points farther north on that trail (Mahr, 1957: 156–58).

Unconvincingly, Heckewelder tried to interpret his Delaware name, *Piimtónink*, for Pymatuning in Mercer Co., on the basis of a folk-etymology (Heckewelder, 1834: 365). In the same publication (*ibid.*: 375) he listed *Pompton* in northern New Jersey, with his Indian informants' Delaware name, *Piimton* (–tom for –ton is a typographical error), and equally unconvincingly interpreted the latter under the spell of the same folk-etymology. It is my opinion that Heckewelder's Indian informants gave him *Piimton* only, because its white adaptation was *Pompton*. At any rate, he should have written *Piimtonink* since Delaware locality names do not appear without the locative final *–'nk*. Therefore, the true Delaware name form for Pompton is not *Piimton* but *Piimtónink*, an identical, though shortened, version of *Piimatóonink* which, as *Pymatuning*, appears in the west, in Mercer Co. The geographical conditions, which caused the Delaware name of the sweating-place, were exactly identical in the east and the west: a river, where the 'sweat-oven' was located; in New Jersey, the Pequanac river, and in NW Pennsylvania, the Shenango. It was imperative to take a cold dip after a sweat-bath anywhere!

In conclusion, I wish to consider the Delaware name for the present Olentangy

river in central Ohio, which, until 1833, had been known as Whetstone river, or Whetstone creek. With remarkable accuracy, its Delaware name has been documented as *Keenhongsheconsepung* (Lee, 1892: I, 17). The true Delaware version is **Kiin·ansh^{l}/·^{l}tkan Sitpu·nk*, literally 'sharp/more-and-more-tool river' (Zeisberger, 1887). 'Whetstones' were a necessity for both the Delaware and the Whites, who had inured the Indians to the use of iron and iron implements. The Delaware name of the river revealed to all interested that one of the head waters, even today called 'Whetstone Creek', was a good source for knife-sharpening stone: Olentangy shale.

SUMMARY

In these pages I have attempted to demonstrate that no Eastern Forest Indians, especially Algonkians, ever would have named a stream or locality without a practical reason. Further, their mentality precluded naming a watercourse or settlement after an other watercourse or settlement, or after a person. Thus, they would never 'repeat' a given river or place name anywhere else, except that they encountered the same or similar conditions as had led to that name in the first place. This also disposes, in part, of a letter to the writer, which contains the following phrase:

> You may have noted that Neshannock, in Mercer County, reproduces Neshannock in New Jersey, and that Lackawannock repeats the Lackawanna of northeastern Pennsylvania. Perhaps Pymatuning is another transfer of names by northern Delawares.

It is left to the reader to form his own opinion.

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Songbirds of America in Color, Sound, and Story. *Arthur A. Allen* and *Peter P. Kellogg.* Cornell University Records, Ithaca, N. Y. i+29 pp., illus., with a 10-inch long-play record (record commentary by A. A. Allen), 1954. 10¼ x 10¼ in., plastic ring binding. $4.95.

This little bookalbum on birds is designed as an introduction to bird study and identification, and attempts to present "everything necessary for understanding and identifying familiar songbirds." It contains short sections on bird migration, the economic values of birds, bird colors, and the habits of birds, along with data on recording the songs, photographing birds, and attracting them to the garden; at the end of the book is a short bibliography and an index.

The larger part of the book consists of write-ups on 24 common birds, arranged in the same sequence as the songs on the record; each write-up is illustrated by a color photograph, and includes information on where the bird is found, its habits, a brief description of its songs, and "memory phrases" for the song. These memory phrases, which attempt to paraphrase the song, are appropriate in a few cases, such as "poor Sam Peabody Peabody Peabody" for the white-throated sparrow, but are a little far-fetched for some others (for example, "cheerio Charlie, how's Mary, care to carry one to Harry" for the rose-breasted grosbeak).

About a minute or less of the record is devoted to each of the 24 birds, the first fifteen or twenty seconds of which is commentary with the song in the background. The quality of reproduction of the songs is fairly good in most cases, but in other cases the song is rather weak in comparison with the level of the commentary.

This combination of descriptive information, color plates, and recorded songs represents a new technique in a publication on birds, and should be a valuable aid to the student.

DONALD J. BORROR

Fifty Years of Botany. *William Campbell Steere, Editor.* McGraw-Hill Book Company. xiii+638 pp. 40 authors.

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The list of authors' affiliations attests the wide and thorough background of the contributors to this book. However, the complete lack of organization of the papers is regrettable; the full index, while useful, cannot provide focal points for the reader, particularly the nonbotanist. The publishers have produced a handsome gold volume with fine format and excellent reproduction of illustration.

CLYDE H. JONES

The Cellular Slime Molds. *John T. Bonner.* Princeton University Press. vii+150 pp. $4.00.

The author has performed a notable service to mycology in bringing into one volume for the first time all the literature on this group of fungi. Active in research with the cellular slime molds for a number of years, Bonner presents the results of the many investigations of the morphology and differentiation of these organisms, as well as the necessary taxonomic considerations, with comments on their significance. Additionally, Bonner points out the many areas needing further investigation. Adequate line drawings and photographs illustrate many details; the index is sufficient; the bibliography is excellent in its completeness.

JOHN A. SCHMITT, JR.

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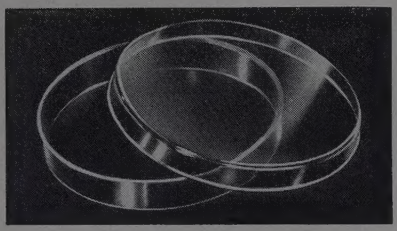

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